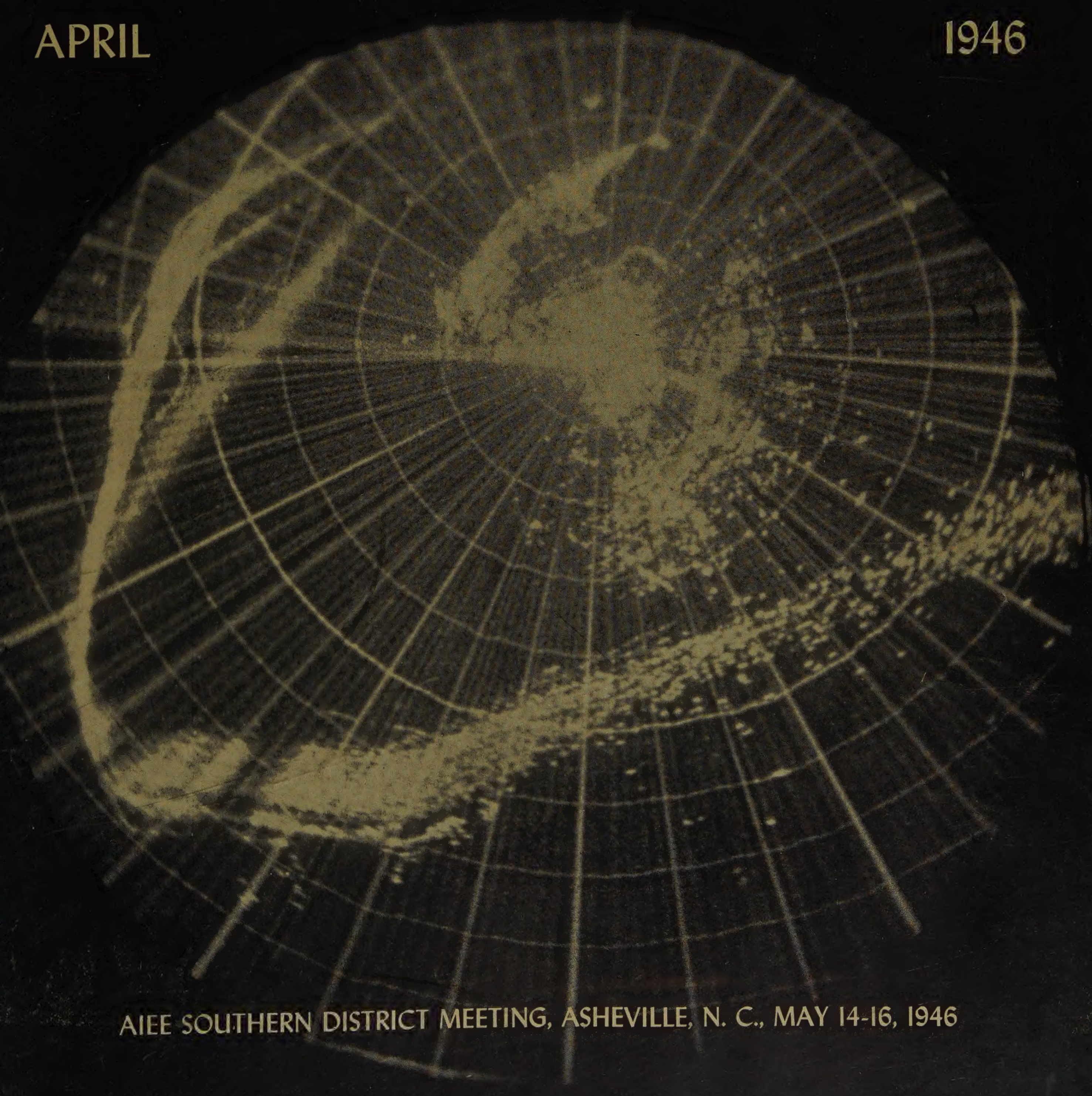
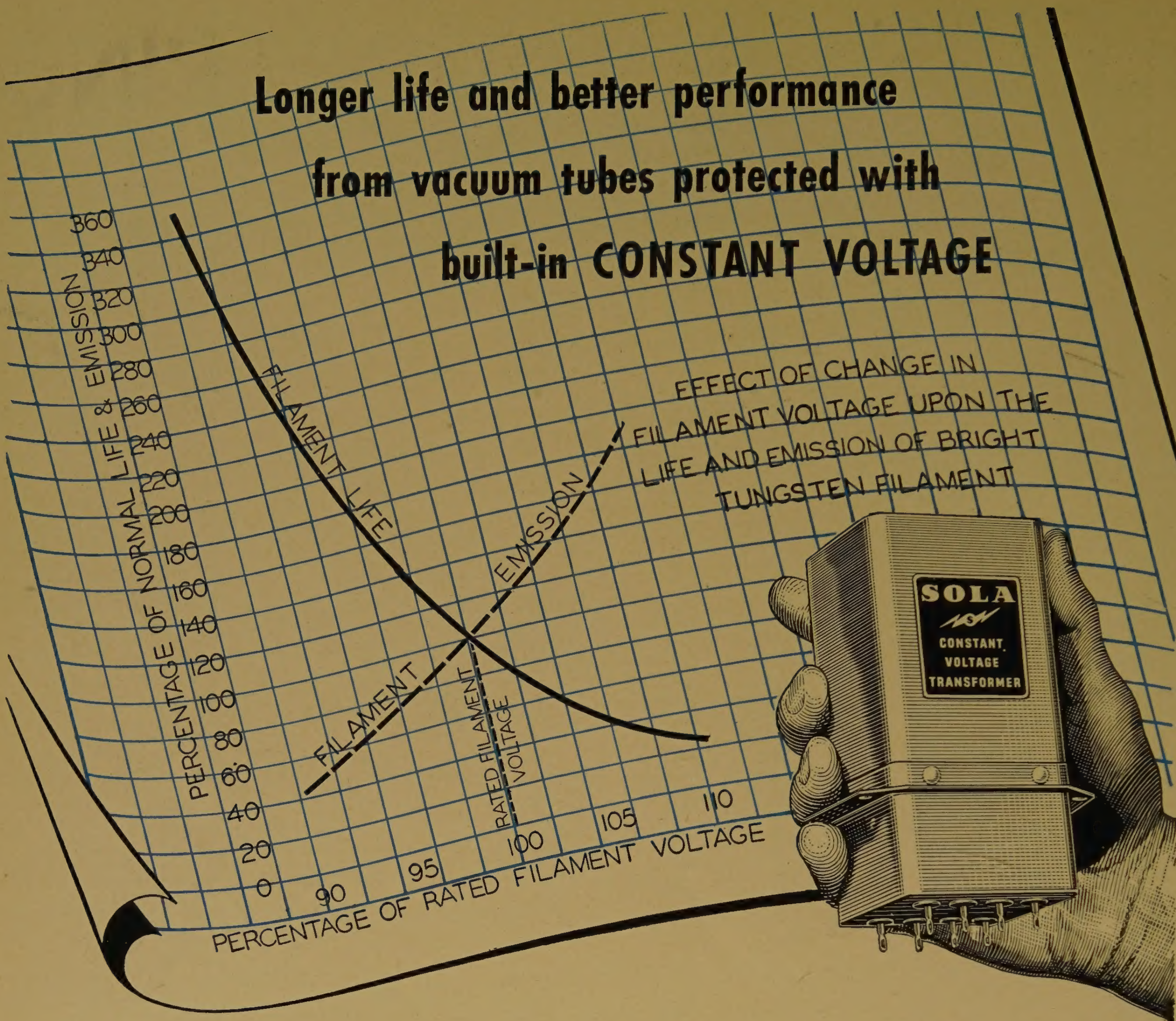
# ELECTRICAL ENGINEERING

APRIL 1946



AIEE SOUTHERN DISTRICT MEETING, ASHEVILLE, N. C., MAY 14-16, 1946


Longer life and better performance
from vacuum tubes protected with
built-in CONSTANT VOLTAGE
EFFECT OF CHANGE IN
FILAMENT VOLTAGE UPON THE
LIFE AND EMISSION OF BRIGHT
TUNGSTEN FILAMENT
PERCENTAGE OF NORMAL LIFE & EMISSION
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
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FILAMENT LIFE
EMISSION
FILAMENT
RATED FILAMENT VOLTAGE
90
95
100
105
110
PERCENTAGE OF RATED FILAMENT VOLTAGE
SOLA
CONSTANT VOLTAGE TRANSFORMER

# ELECTRICAL ENGINEERING

Registered United States Patent Office

APRIL
1946

**The Cover.** Five-hundred airplane Royal Air Force bomber raid as seen on off-centered PPI (plan-position indicator) of microwave ground radar; range circles ten miles apart. Wispy trail of signals at left of picture is result of "window" counter measure—tin foil strips dropped to confuse enemy radar. Effect on microwave radar is slight.

Photo courtesy Radiation Laboratory, Massachusetts Institute of Technology



## TRANSACTIONS SECTION

*(Follows EE page 192; a preprint of pages 177–240 of the 1946 volume. Any discussion of these papers will appear in the June 1946 "Supplement to Electrical Engineering—Transactions Section" and in the 1946 volume.)*



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# HIGHLIGHTS........

**District Meetings.** As this issue of *Electrical Engineering* reaches the membership, late as usual, the South West District meeting at San Antonio probably will be over, and the North Eastern District meeting at Buffalo immediately imminent. Next will be the Southern District meeting at Asheville; then the summer convention at Detroit. All information pertaining to the programs of these meetings, including abstracts of scheduled technical papers, has been and will continue to be published in *Electrical Engineering* as it becomes available. Reports covering these meetings, as well as general-interest material available from them, will be published in *Electrical Engineering* as soon as possible following the meetings. Most of the abstracts for the Buffalo meeting are in this issue (*pages 174–5*).

**Engineering Organization.** Four different plans for the possible reorganization of the engineering profession are included in the initial progress report of the professional activities subcommittee of the AIEE committee on planning and coordination, incidental to the latter's current study of ways and means of improving AIEE activities and membership services. These plans are published, not as recommendations, but to stimulate discussion at Section and District meetings, and ultimately at the forthcoming summer convention in Detroit (*pages 169–73*).

**Circuit Breakers.** Field tests made by the Hydro-Electric Power Commission of Ontario prove the feasibility of testing 138-kv circuit breakers on a large system provided necessary preliminary work is done to establish the generator and line arrangement required to produce and control the specified value of short circuit current (*Transactions pages 199–204*). Evolving from self-contained air circuit breakers which later were supplemented by circuit breakers operating on the principle of magnetic deionization of a single arc, the latest development is a line of magnetic air circuit breakers for ratings up to 500,000 kva and 15 kv (*Transactions pages 220–3*). To meet exacting performance requirements a new line of high-voltage outdoor tank-type oil circuit breakers incorporates improvements in the design of the interrupter, the bushing, the tank and top frame, and the operating mechanism (*Transactions pages 224–31*).

**ASA in Consumer Field.** A working understanding appears to have been reached between the American Standards Association and the United States Department of Commerce whereby ASA has achieved recognized standing in the field of consumer goods, subject to certain qualifications stipulated by the Department of Commerce. Accordingly, plans are well under way to expand the ASA financial structure, as well as to broaden the incidence of support and participation in the ASA (*pages 183–4*).

**Research Legislation.** Apparently renouncing the recommendations made by a majority of the many scientists in voluminous testimony before the Senate Committee during recent months, a new Bill, S1850, would establish precepts and procedures whereby government would have complete control not only of research, but of developments growing out of research. Competent observers view this concerted move with alarm, and believe that it is a matter of direct concern to every engineer and scientist (*pages 185–6*).

**Radar.** The characteristics and performance qualities of any radar system are shown to be dependent not only upon the quality of the component parts, but also upon the system planning and the nicety with which the parts are fitted together (*Transactions pages 209–15*). "Now can be told" the history and physical makeup of the Shoran radar, so effective for precision position-finding in aerial navigation and blind bombing (*Transactions pages 232–40*).

**Model Law Endorsed.** Action has been taken by the AIEE board of directors recognizing the registration of engineers as a continuing practice, endorsing the model law for professional engineers and land surveyors, and authorizing the establishment of a standing committee on registration of engineers. Joint Student Branches also were authorized (*pages 167–8*).

**Airplane Power Plants.** Two new power plants for airplanes, the gas turbine–jet propulsion engine and the gas turbine–propeller drive, are expected to play a significant role in aviation of the near future. Although it is not likely to displace the reciprocating engine in the fields of low power and low speed, the advantages of the gas turbine indicate its probable use in the higher speed ranges (*pages 160–3*).

## News . . . . . . . . . . . . . . 164



**Atomic Power.** Speculation as to the potentialities of atomic energy, both as a weapon and as an industrial tool, has been widespread, with predictions that range from the ultra-conservative to the fantastic. In an attempt to clarify the situation three winter convention talks are published, giving the views of three recognized authorities (*pages 145–50*).

**Inertia Throat Microphones.** The theory and design of magnetic inertia throat microphones is described with special emphasis on the treatment of sound-powered and high-articulation throat microphones. These microphones have a band-pass filter character with a sharp high frequency cut-off to cut out high frequency noises (*Transactions pages 187–91*).

**Polyphase Reluctance Motors.** The performance calculations presented by Doherty and Nickle in 1926 in their classic paper on synchronous machines have been rearranged and simplified for the benefit of the engineer who has occasion to design small reluctance motors (synchronous motors without field excitation) (*Transactions pages 191–3*).

**Westinghouse Centennial.** Initiating a series of activities planned to honor the centennial of the birth of George Westinghouse, the American Society of Mechanical Engineers recently sponsored a dinner at the Engineers Club in New York (*pages 189–90*).

**Variable Ratio Transmission.** An electric governor is described that is intended to provide the automatic control required for parallel operation of electric generators in large aircraft which involve heavy consumption of electric power and wide ranges in engine speeds (*Transactions pages 194–8*).

**Thin Permalloy Tape.** With the increasing need for efficient magnetic structures at high frequencies, such as pulse transformers for radar, thin permalloy tape has been developed which may be insulated and formed into cores in a continuous operation (*Transactions pages 177–83*).

**Societies' Librarian Retires.** For 29 years the guiding mainspring of the Engineering Societies Library in New York, Doctor Harrison W. Craver recently turned over his office to Ralph H. Phelps (*page 189*).


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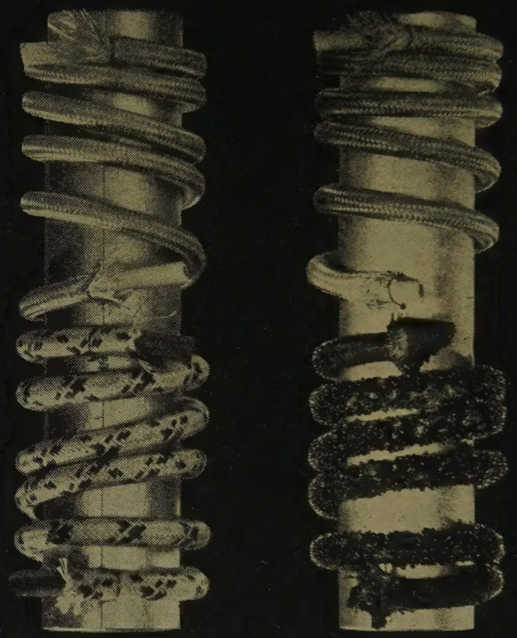
**VARNISHES** *exclude moisture*

**RESINS** *withstand heat*

**GREASES** *insure lubrication*

**SILASTIC**

# *harness electricity*



Silastic, the Dow Corning silicone rubber, is the only rubber-like insulating material that does not melt, harden, or crack from below −70° F. to above 500° F. Silastic insulated lead wire (top) shows no change after one hour at 500° F. Organic insulation (bottom) has softened and exuded freely through the braid.

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FIRST IN SILICONES

# Atomic Power in a Peacetime Economy

PROGRESS in nuclear research was reviewed in *Electrical Engineering* for March. In cognizance of the fact that atomic energy may be potentially as valuable an instrument of peace as it was of war, the following supplemental articles are presented, reflecting the views of recognized authorities concerning the role of atomic power in the postwar world, with particular emphasis on possible applications and the economics involved. The articles are based on addresses prepared by C. G. Suits (M '41) vice-president and director, research laboratory, General Electric Company, Schenectady, N. Y., Philip W. Swain, editor, *Power*, McGraw-Hill Publishing Company, Inc., New York, N. Y., and J. A. Hutcheson, associate director, research laboratories, Westinghouse Electric Corporation, East Pittsburgh, Pa., for the symposium on nuclear energy held during the recent AIEE winter convention in New York.

## I. Peacetime Uses of Atomic Energy

C. G. SUITS

SINCE AUGUST 6, 1945, there has been much speculation about peacetime uses of atomic, or nuclear, energy. The proposed uses range from automotive power plants, through ship propulsion, to interplanetary rockets. If one weights all of the doubtful physical and chemical factors heavily on the optimistic side, and neglects the economic factors completely, very few of these applications can be ruled out entirely. Which of these possible applications of nuclear energy is likely to become practical, and when, depends upon the amount of research, development, and engineering effort which can be devoted to these physical factors in the immediate future. The object of this article is to consider some of the possible applications of nuclear energy, to illustrate what steps must be taken, primarily in research, to bring them into reality.

### REVIEW OF BASIC FACTS

That energy may be produced by the disintegration of the nucleus is not new. That fact has been known since the discovery of natural radioactivity 50 years ago by Becquerel. Many years ago, one could get a very large number of kilowatt-hours per pound from radium. A pound of radium makes a miniature atomic power plant that runs for a long time at the rate of about 1/10 kw. The difficulty was that radium did not then, and does not now, come by the pound but rather by the milligram at a price of $20 per milligram. In 1939 a new type of nuclear disintegration called fission was discovered to occur in uranium, thorium, and some other elements. Of these, in comparison with radium, uranium is relatively abundant and may be bought by the pound at a cost of a few dollars. However, in uranium only the isotope U-235 undergoes fission. This isotope is present as less than one per cent of the natural material, although, under the most favorable circumstances, the bulk of natural uranium, suitably purified, may be converted to fissionable elements so that nearly all of it may be used to create nuclear energy. The fission of one pound of U-235 produces 10 million kilowatt-hours.

Uranium in a pure condition, or enriched in the isotope U-235, may be used in a chain reacting pile to produce controllable heat energy. This nuclear reaction in a pile is obtained at any temperature permitted by the materials of construction which include the fissionable elements, the moderators or slower-downers, the heat transfer medium, the various mechanical parts required for control, and, finally, the radiation shield. During operation the fissionable material is used up slowly and nuclear reaction products, some of them toxic, accumulate. This means that operating personnel must be shielded from very intense radiation, especially neutron radiation accompanying the reaction. Because of a surface-to-volume effect, the pile must contain a certain minimum quantity of fissionable material to react satisfactorily. The whole mechanical assembly required for a chain reacting pile, and some of the problems of operation, become analogous to a stoker-fired boiler. The fissionable material or fuel must be fed in, the reaction products or ashes must be removed, and the mechanical parts must tolerate the radiation and temperature stresses.

Confining the penetrating radiation of the pile is a far more serious matter than confining the steam or mercury vapor in a typical boiler. The shielding for this purpose must be equivalent to several feet of steel, and there is little prospect that this will be reduced in the typical case. For this reason small fission power plants appear to be out of the question at present as a minimum size of approximately 50 tons is required.

Let us consider the economy of a chain reacting pile as a heat energy source. The fission energy in one pound of U-235 equals the heat energy in 1,000 tons of coal but plants for the production of uranium and element 94 are expensive to build and operate. According to General Leslie R. Groves, the United States Government's investment at Oak Ridge, Tenn., and Hanford, Wash., totaled

1.3 billion dollars with an annual operating cost of 258 million dollars. He did not state how much fissionable material is produced in these plants. Because U-235 and the other high purity materials of a pile are very expensive, because the pile structure and its auxiliaries are expensive, and because of the required skilled personnel, heat from a pile cannot compete yet with heat from a device which burns conventional fuels.

## PROSPECTIVE APPLICATIONS

With the foregoing facts as a basis, some prospective applications of nuclear energy, that is, of chain reacting piles, may be considered. The fact that these piles must be large immediately precludes a host of low power applications. Automotive power is out. Railroad locomotive power is almost certainly out. Large ship propulsion seems not only possible, but attractive, though on a strategic rather than a competitive basis. An advantage gained in the space required for fuel is offset partly by the space required for shielding. Evidently a detailed research and engineering study will be required to evaluate this application. Perhaps large electric power plants are practicable in areas, Australia for example, where there is practically no conventional fuel but abundant natural resources of many other types. Atomic power plants for electric power generation probably, at some time in the distant future, will compete successfully with coal, oil, and water power energized plants. In fact, this ultimate possibility is an important hedge against long-range exhaustion of the natural oil and coal reserves. However, it should be borne in mind that there is nothing in the present status of nuclear research to justify the hope of direct conversion of nuclear to electrical energy and so this competition with conventional fuel, as far as is known today, must be evaluated from a consideration of heat production as a step in the conversion cycle.

In a typical modern steam plant, the cost of generating electric power may be made up of the following items, which, of course, do not include transmission and distribution costs:

| | Costs in Cents per Kwh |
|---|---|
| Fuel | 0.25 |
| Plant investment | 0.25 |
| Plant operation | 0.1 |
| Other | 0.1 |
| | 0.7 |

It is clear that a reduction in the cost of fuel to zero, as in the case of the free potential energy in a water power generating plant, will provide some, but not a spectacular, reduction in the cost of electric power, as the many other factors which enter into the cost of power delivered to the consumer will remain unchanged.

## NUCLEAR ENERGY ON A COMPETITIVE BASIS

What must be done to make nuclear energy successively more competitive with conventional fuels? The required steps are very clear, and are primarily research steps. The basic problems of isotope separation must be studied. The physical and chemical reactions of the pile must be studied exhaustively with heat production, rather than bomb materials, as the objective. The host of serious metallurgical problems associated with the strength, durability, and radiation properties of alloys under intense neutron flux must be solved. The health and protection problem must be systematized and simplified. Finally, and most important, basic scientific knowledge must be reduced to engineering practice. This all requires a comprehensive research-development-engineering approach with long-range objectives.

Development programs directed toward the use of nuclear energy for power production should be undertaken by all branches of the power industry, probably with governmental support, but not in anticipation of quick application in competition with conventional fuels. A large amount of fundamental research in nuclear and related fields also will have to be done in support of the long-range program. As much of the equipment required in nuclear research, such as cyclotrons and betatrons, is large and expensive, it will be necessary for the government to support the fundamental program too, if it is to progress at an adequate rate.

During the war, the United States largely used up its accumulated surplus of basic knowledge of the nucleus. The dividend was the atomic bomb. Without further delay, this surplus must be restored in preparation for the important peacetime job for the nucleus—power production.

The development of economic atomic power is not a simple extrapolation of knowledge gained during work on the atomic bomb. It is a new and difficult project and great effort will be required to reach a satisfactory answer. Needless to say, it is vital that atomic policy legislation now being considered by the Congress of the United States recognizes the essential nature of this peacetime job, and that it not only permits but encourages the co-operative research-engineering effort of industrial, government, and university laboratories for this task.

Every scientist knows that the sure way to court trouble is to predict the scientific future. Bold predictions usually fall short of realization. For that reason, which can be illustrated by many examples, it is doubtful if anyone clearly foresees the potentialities of the nucleus.

In the immediate future the techniques and materials of nuclear reactions will be a tremendous stimulus to research in physics, chemistry, metallurgy, and the biological sciences. It is questionable, however, if these things, as important as they are, can be compared in importance with the ultimate possibilities of nuclear

power. The outline of this atomic age of the future is perceived as dimly now as was the shape of the electronic age when the Edison effect first was discovered.

The nuclear reactions in a pile chiefly lie in the energy range below 10 million electron volts. Until recently the most energetic laboratory radiation was from the cyclotron, and it did not exceed 40 million electron volts, but now a whole new energy range between 50 million electron volts and 100 million electron volts is being explored with the large betatron at Schenectady and generation of still higher energy particles of the cosmic rays, up to $10^8$ million electron volts will uncover even further domains in the nucleus.

The field of nuclear physics offers a vast unknown to explore, an endless frontier. The goal is the vast storehouse of energy in the atom—10 billion kilowatt-hours per pound. Today, by fission, only 1/1,000 of this potential energy has been obtained. To increase that fraction is the task confronting nuclear research.

## II. Economics of Atomic Energy

PHILIP W. SWAIN

BLUNTLY STATED, this article attempts to reach economic conclusions regarding atomic power without possessing the essential data. The Smyth report left much unsaid. Since Smyth, no significant new facts have been made public. The vast atomic-energy literature of this "post-Smyth" period is either a restatement of Smyth, a presentation of what was public knowledge before Smyth, an interpretation, or a prediction. For sound reasons of national security, all further information of fundamental character has been kept secret.

Those who write and speak on nuclear energy must be divided into two groups:

1. Those who do not tell because they do not know.
2. Those Manhattan District insiders who do know and therefore cannot tell.

I fall in the first group.

Following are values unknown to me but essential to valid conclusions regarding atomic power economics:

1. Present and estimated future cost of natural uranium.
2. Present and estimated future cost of natural uranium sufficiently purified for use in piles.
3. Present and estimated future cost of uranium 235 in various concentrations (in U-235–U-238 mixtures).
4. Pile efficiency obtainable with various concentrations.
5. The maximum practicable temperature of pile operation.

This article therefore must be presented on an "if" basis. It cannot even be on the level of the schoolbook problem where the data, though imaginary, are *given* at least. Perhaps then the article should be retitled "how to prepare to think economically about atomic power if and when the necessary data become available."

Fortunately the world *does* know the composition of commericial uranium and the energy released by the fission of U-235, so let us begin at that point. Natural uranium contains 0.7 per cent of U-235; 140 pounds of natural uranium contain 1 pound of U-235. The complete fission of the atoms in one pound of U-235 releases in heat energy 11.4 million kilowatt-hours, 39 billion Btu, 30 trillion foot pounds, or the heat in 1,400 tons of good coal.

As 140 pounds of natural uranium contains one pound of U-235, one pound of natural uranium equals ten tons of coal. From this one might reach the false conclusion that coal would have to sell for 20 cents a ton to compete with natural uranium as a fuel.

### NATURAL URANIUM PILES

The daily operation of the big carbon-uranium piles at Hanford, Wash., is proof that natural uranium can be used to generate heat at a controlled rate, with the artificial element plutonium as a by-product, even though at Hanford the plutonium (substitute for U-235 in bombs) is the product and the heat an unwanted by-product wasted to the Columbia River at the rate of several hundred thousand kilowatts.

Here are some of the things we are permitted to know about these natural uranium piles, great water-cooled carbon blocks with holes in which are inserted uranium cylinders sealed in aluminum cans. These piles "cook" at a completely controllable rate. They give off heat, and produce plutonium by the action on the U-238 of neutrons produced by U-235 fission. Long before the mass of U-235 in the pile has been consumed the pile slows down, "poisoned" by the accumulation of fission products, so the charge either must be renewed completely or taken out and chemically cleaned up.

To work at all, a natural uranium pile must be very large. With only 0.7 per cent of U-235, natural uranium is a very "weak" atomic fuel. One might view it as the nuclear equivalent of a very high-ash lignite disinclined to burn at all. If the pile is too small it will not maintain a chain reaction. Also, if the natural uranium pile becomes too hot the neutrons are speeded up, make fewer nuclear hits, and the chain reaction dies out unless the pile is made extra large to protect against this.

If the U-235 is enriched—that is, raised above the natural 0.7 per cent by the gaseous diffusion process or other means—a smaller pile can be made to work, and a larger percentage of the available heat of the U-235 can be recovered before the charge must be renewed.

This matter of limiting size may not be particularly important for nonmobile applications of atomic power. The need for heavy shielding and expert operation and close government inspection in any case would limit economic atomic-heat installations to fairly large plants; central electric power plants, central heating plants, and large industrial steam and power plants.

## EFFECT OF U-235 CONCENTRATION

Neglecting the size limitation, therefore, it would appear that the optimum percentage of U-235 would be determined by balancing the cost of concentrating against the lower pile efficiency with low concentrations.

Here my estimates suffer greatly from lack of any data, even the roughest approximations. I merely can say that the efficiency of the natural uranium pile is extremely low, that a moderate increase in U-235 gives a substantial improvement in pile efficiency, that the cost of concentrating the U-235 is very high, particularly in the early stages.

To dramatize this last statement, consider 140 pounds of natural uranium containing 1 pound of U-235, or 0.7 per cent. Getting rid of 69.5 pounds of U-238 will raise the U-235 percentage to 1.4 per cent. Getting rid of another 69.5 pounds of U-238 will raise the U-235 percentage to 100.

If and when data become available on the cost of U-235 per pound in various concentrations, and on the corresponding pile efficiency, one can multiply 39 billion Btu by the efficiency to obtain the recovered heat per pound of U-235, and divide this by the cost per pound of U-235 to obtain the Btu recovered per fuel dollar for the given U-235 concentration.

One can guess that the optimum percentage of U-235 will be substantially more than the natural 0.7 per cent, but far less than 100 per cent.

This article can offer no hint as to present pile temperatures, or the limiting temperatures believed to be practicable in pile operation. Official statements suggest that it may be difficult to operate at temperatures high enough for power purposes. It seems quite possible, however, that such statements may be founded on excessive ideas as to what temperatures are required commercially.

## PROCESS STEAM MAJOR APPLICATION

Much publicity has been given to steam electric power plants operating at 1,400 pounds per square inch, and at temperatures up to 900 degrees Fahrenheit or higher. Now if atomic energy is to be used to save coal, it makes no difference whether the coal saved makes steam for electric generation or for space heating and process. The combined coal and equivalent coal consumption of all steam electric stations in the United States in 1945 was just under 100 million tons. In the same year medium and large industries burned about 200 million tons in power-type boilers. Most of the steam so produced was applied to heating and process at pressures of 50 pounds per square inch gauge or less. A large part of this steam never went to any prime mover.

Note that 50 pounds per square inch gauge saturated steam, suitable for the majority of process and heating applications, has a temperature of 298 degrees Fahrenheit. Of those plants generating by-product power in turbines exhausting to process, the majority can be taken care of by steam at less than 300 pounds per square inch gauge (422 degree Fahrenheit saturation temperature) and 650 degree Fahrenheit total steam temperature. It must be remembered that back-pressure turbines require a much lower throttle temperature than condensing turbines for a given throttle pressure.

Even if the 650 degrees Fahrenheit should prove to be a pile limitation, the pile presumably could be used to produce the saturated steam at 422 degrees Fahrenheit and then normal fuels used in small quantity to superheat it. Electricity also has been suggested as a means of superheating in such cases, but this obviously is uneconomic.

Among the suggested causes limiting pile temperatures are corrosion or softening of the uranium or the aluminum cans, wastage of the carbon, and thermal stresses in the carbon structure caused by excessively steep temperature gradients. This, in turn, suggests that the temperature limit is not fixed precisely, but rather can be raised considerably if the owner is willing to spend more for the plant and incur more difficulty in operating it.

## NO SAVING IN PLANT COST

It is obvious that the replacement of coal by uranium affects only those parts of a power plant devoted to steam generation and the handling of the fuel and ash (or other waste and by-products). While less space would be required for uranium storage, there is little hope that all these elements would cost less either to build or to operate and maintain than those of a conventional steam plant. Heavy radiation shielding and elaborate instrumentation would be needed, also highly skilled operators and inspectors. The disposal of radioactive by-products would be a most difficult matter. Tubes or drums still would be needed to contain the water and steam under pressure.

This all leads up to the conclusion that U-235 will not be used commercially for large-scale steam generation in stationary plants until it can compete with local coal, oil, or gas on a fuel dollar basis, with allowances for the relative steam generating efficiencies (and in some cases for the temperature limitations of the atomic piles).

Table I lists prices at which U-235 would break even with other fuels, "other things being equal." Remember that other things rarely will be equal. On the other hand, note that this does not imply the need to purchase separated U-235. It implies U-235 in the concentration used.

Without further particulars, those "in the know" say that U-235 substantially concentrated costs many times the amounts tabulated. Past industrial history suggests that improved methods eventually will cut the cost to a fraction of present costs. Whether this eventually will bring uranium into actual competition with coal the writer has no way to determine. Take your choice of guesses that range from ten years to centuries.

**Table I. U-235 Could Compete at These Prices**
*(Other Things Being Equal)**

| Common Fuel | Assumed Prices (in Dollars) | Comparable Prices for U-235, Dollars Per Pound (Nearest Thousand) |
|---|---|---|
| Coal (13,000 Btu) | 6.00 per ton | 9,000 |
| | 12.00 per ton | 18,000 |
| | 15.00 per ton | 23,000 |
| Fuel oil (150,000 Btu per gallon) | 0.02 per gallon | 5,000 |
| | 0.04 per gallon | 10,000 |
| | 0.08 per gallon | 20,000 |
| City gas (500 Btu) | 0.50 per 1,000 cubic feet | 39,000 |
| | 1.00 per 1,000 cubic feet | 78,000 |
| Natural gas (1,000 Btu) | 0.25 per 1,000 cubic feet | 10,000 |
| | 0.50 per 1,000 cubic feet | 20,000 |
| | 1.00 per 1,000 cubic feet | 40,000 |
| Gasoline (150,000 Btu per gallon) | 0.10 per gallon | 26,000 |
| | 0.20 per gallon | 52,000 |
| | 0.30 per gallon | 78,000 |

* Note that "other things" are never equal. U-235 in normal uranium form is by far the cheapest, but involves use of excessively large and inefficient "piles." The unit cost of the U-235 in enriched mixtures increases with the degree of enrichment. Over-all cost comparisons can be made only for a specified concentration of U-235 and for apparatus suitable for that particular concentration. Possible explosion danger and need to protect personnel against radiation are other important considerations.

### NO ECONOMIC REVOLUTION

One thing is certain, however, those who look for an economic revolution resulting from coal-free power are on the wrong track. Coal is a mere fraction of the delivered cost of power. For years we have had technically practicable ways to make power without coal; hydroelectric power, wind power, tide power, sun power. Each of the last three could produce every kilowatt hour used in the United States today and thereby save *all* the coal used in central power stations, but it could not be done economically. Hydroelectric power does little better (and sometimes much worse) than run neck and neck with power from coal-fired steam-electric plants.

If we, nevertheless, should use atom splitting to replace the 100 million tons of utility coal and the 200 million tons of large-industry steam coal, all at $6 per ton, for instance, the saving before allowance for nuclear costs would be little more than one per cent of the national income. This is no revolution, except for coal men.

### CONCLUSION

Let me conclude with a few random thoughts for the record.

First, note that cost of natural uranium, even if it be raised from $2 per pound to $10 per pound, is a negligible factor in the cost of atomic fuels. The cost resides mainly in the process of concentrating the U-235, although an appreciable percentage lies in purifying the natural uranium.

Next, I must not seem to rule out the possibility of piles that will make use of plutonium as well as U-235 and other "transuranic" elements, or of other natural elements such as thorium. I also must admit the theoretical possibility that some day we may secure large amounts of energy by synthesizing the light elements into heavier elements, just as the sun makes its heat by turning hydrogen into helium. Although I shall not go into that question I see some promise in the direct atomic heating of helium in a closed circuit gas turbine.

Finally, I should state my sincere belief that power-plant economics is by no means the most pressing problem in the field of nuclear energy. The main problem is that of atomic bombs and rockets. Our first task is to contrive international arrangements which can prevent the mutual destruction of nations by atomic weapons. Meanwhile, let us maintain atomic research as the second responsibility, for "nucleonics" promises developments as strange and wonderful as those that grew from the experiments of Faraday and other electrical pioneers. Nuclear-biological research alone may yield results matching the importance the future power-plant applications of atomic energy.

## III. Application to the Generation of Electric Power

J. A. HUTCHESON

IT IS ONLY SINCE THE TURN of the century that the general subject of nuclear physics has been advanced to its present state. Prior to World War II much research and investigation had been carried on in this field with the result that some of the potentialities locked within the atom were becoming apparent to a few individuals. Books had been written which contained enough information to make people in engineering fields generally aware that the application of atomic energy in the field of the generation of electric power might some day be a possibility.

Nevertheless, a competent survey of physics which was published in 1943 contains this statement: "The relatively scarce isotope of uranium of atomic weight 235 is interesting, because it is the one which is usually split. If it were possible to obtain a large quantity of this isotope alone, it would yield in splitting a huge store of energy which might be applied to running engines of war. Dangerous radiations would be emitted, however, in this process, and on all accounts we may be glad that the separation of isotopes is a very difficult and inefficient process." Thus, we see that three years ago there was still very little available knowledge.

When the first atomic bomb was dropped on Hiroshima last August, the situation was altered overnight. It was immediately apparent that here was an application of atomic energy which was of sufficient magnitude to indicate that new knowledge was available in the field of nuclear physics. So far as the engineering profession knew prior to that time, the fission of uranium was accompanied by the release of energy which, though relatively very great, it still required sensitive instru-

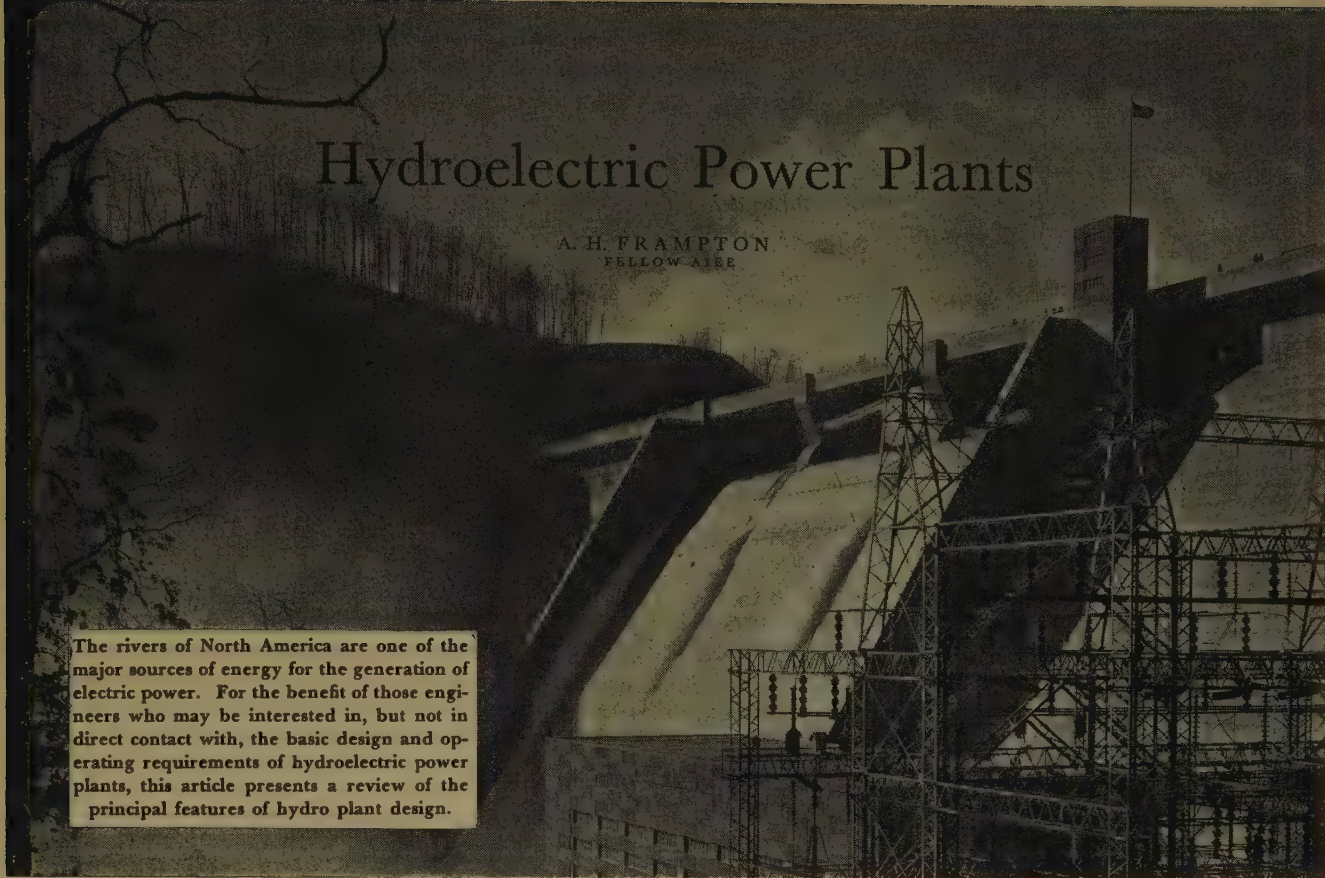
ments to detect. Obviously, during the war years something must have happened which very radically altered this condition. A broad idea of what had happened was forthcoming with the publication of the Smyth Report, and following its publication, many conferences and meetings were held at which the various aspects of atomic energy were discussed with some freedom and with the consequent release of much information. The engineer now has at his command a substantial store of information on which to base a new consideration of the problem of the application of atomic energy to the field of generation of electric power, though not enough information is available to permit the engineer to make an unqualified prediction.

An analysis of the information contained in the Smyth Report and elsewhere brings to light several facts pertinent in this consideration. For example, Doctor A. H. Compton has said, "At present controlled atomic power in the form of heat is in continuous production in large quantities at several plants, especially those at Oak Ridge, Tenn., and at Hanford, Wash. The heat from these plants is a by-product and is carried away in the one case by air and in the other by a stream of water." Not a great deal has been said about the amount of power available in this form at those locations. However, by inference it seems reasonable to suppose that it must be in the order of many thousands of kilowatts. This is borne out by a discussion reported in the Edison Electric Institute *Bulletin* for December 1945, on the subject of atomic energy which included several statements indicating that it was technically possible to develop a power plant of 100,000-kw capacity. The consensus seemed to be that, while it was technically possible, it might not be economic at this time, and further that intensive research and development would be required prior to the attainment of such a plant.

From Doctor Compton's statement it is apparent that the power is available in the form of heat in water, and therefore it seems logical to suspect that the earliest applications of atomic power will be similar to the present scheme of obtaining power from coal, in that steam probably will be used to drive the turbine and that the heat liberated in connection with the fission of some material will be used to form the steam. If this is so, the problems associated with this work will be those brought about by the replacement of the present boiler and coal combustion equipment with some suitable heat exchanger and atomic power equipment.

Many difficulties have to be surmounted before a satisfactory power plant will be achieved. The major one that seems to present tough problems arises from the fact that the whole operation is accompanied by the production of very intense and dangerous radiations. Doctor Compton, in speaking on this subject, has said, "There is, however, a lower limit to the size and weight of an atomic power plant that is imposed by the massive shield needed to prevent the neutrons and other dangerous radiations from getting out. Next to cosmic rays these radiations are the most penetrating that we know, and for a plant designed to deliver, for example, no more than 100 horsepower, are enormously more intense than the rays from a large supply of radium or an X-ray tube. To stop them, a shield equivalent in weight to at least two or three feet of solid steel is needed. There are basic laws of physics that make it appear very unlikely that a lighter shield can be devised. This means that there is no reason to hope that atomic power units for normal uses can be built that will weigh less than perhaps 50 tons." These radiations induce artificial radioactivity in most things they strike, which means that the steam passing through the turbine, for example, probably will be radioactive. The by-products of fission also are radioactive and presumably will need to be removed from time to time. Consequently, special methods of handling and storing them will have to be provided.

With these problems in mind and with certain assumptions about cost of equipment and raw material, it is now possible to make some estimates as to the economic possibilities of the application of atomic energy in the electric power field. A very comprehensive report on this subject has been prepared under the direction of Mr. C. F. Wagner of the Westinghouse Electric Corporation. An assumption is made in the report that an atomic-powered 100,000-kw plant could be built, in which the cost of the equipment and plant necessary to provide steam for the turbines would be about $12,000,000. This is roughly four times the cost of the steam end of an equivalent power plant using coal as a fuel. Calculations were made comparing the cost of power obtained from this atomic power plant with that obtained from a coal power plant. These calculations included amortization of the investment in each case at the rate of 15 per cent per year. It was assumed further that the atomic fuel would be refined natural uranium such as was used in the "piles" at Hanford and Oak Ridge. If it is assumed that this material costs $20 a pound, the total cost of the generation of electric power in the atomic power plant appears to be slightly less than in the coal-fired plant, assuming that coal costs $5 a ton. This comparison would indicate that the possible application of atomic energy to the production of electric power is sufficiently feasible to warrant a careful and thorough investigation. Undoubtedly, work of this kind is going forward; and, consequently, it seems reasonable to predict that within a few years sufficient knowledge will be at hand to permit an accurate analysis to be made which may well indicate that atomic energy as the source of power for an electric power system will be technically feasible and economically practical. From what can be seen now, it appears that the technical problems rather than the economic problems are the ones which must be solved before atomic power plant of the future is practical.




# Hydroelectric Power Plants

A. H. FRAMPTON
FELLOW AIEE

**The rivers of North America are one of the major sources of energy for the generation of electric power. For the benefit of those engineers who may be interested in, but not in direct contact with, the basic design and operating requirements of hydroelectric power plants, this article presents a review of the principal features of hydro plant design.**

ELECTRIC UTILITY SYSTEMS on the North American continent derive their power supply predominantly from generating stations of either the steam-electric or hydroelectric type. It happens that in some utilities the one type predominates, while in others it may be almost or even completely absent. Consequently, the system engineer and power plant designer may acquire a full familiarity with the problems of location, design, and interconnection with the system of the one type of plant, while being less familiar with the problems associated with the other. It is assumed that the readers of this article are fully familiar with steam-electric plant problems, but would be interested in a general outline of some of the variations encountered in hydroelectric plant design.

In discussing the basic features of design of the hydroelectric plant it may be assumed that it is being added to a system already supplied entirely from similar sources, or that it is being added to a system wherein the major sources of supply are existing steam-electric plants. This article is limited to the former situation.

Hydroelectric plant design differs from the design of metropolitan-type steam stations in several major particulars. The sites for development are fixed by nature and may be near to, or remote from, the major load centers involved. The daily, seasonal, or annual load factor at which such plants may be operated usually is not subject to wide variation. The problems of interconnection with the system may be different, normally requiring long high-voltage transmission lines to load-center receiving stations, with provision for load and voltage control and synchronous condensers. Frequently, more than one site is available, in which case the order of development and the designed characteristics of each plant and of its associated transmission system may be governed by an over-all program embracing all sites.

## RIVER FLOW

The design of any component part of an electric utility system must rest upon adequate knowledge of the fundamental factors involved. In the hydroelectric plant, the first consideration is the water supply or stream flow. In both the United States and Canada, for the rivers and streams on which potential water power sites exist, data regarding the stream flow are compiled by governmental agencies and through such agencies are made available to the designing engineers. In most cases, such data have been collected over a period of many years. The longer this period of record the more dependable will be the operating characteristics which

Essential substance of a paper presented at a meeting of the power group of the AIEE Chicago (Ill.) Section, October 11, 1945, and presented informally in New York, N. Y., at the 1946 AIEE winter convention session on "Hydroelectric Systems" under the sponsorship of the AIEE committee on power generation.

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are incorporated in the design of the hydroelectric plant.

Most rivers, at least in the northern part of the United States and in Canada, have widely varying rates of flow. For example, it is stated that the minimum natural flow of the Tennessee River near its junction with the Mississippi River approximated 4,500 cubic feet per second, whereas its probable unregulated flood was nearly 1,000,000 cubic feet per second. At the Chats Falls site on the Ottawa River, which river forms the boundary between the Canadian provinces of Ontario and Quebec, a variation from 9,000 cubic feet per second to 176,000 cubic feet per second was measured, even though this river is partly regulated. On the converse, the St. Lawrence River presents an unusual example of natural regulation, the flow varying only between the approximate limits of 160,000 and 310,000 cubic feet per second, because of the regulating effect of the Great Lakes.

Economical hydroelectric development, therefore, normally includes some form of river flow or flood control, either at the site of the development or at suitable points elsewhere on the watershed. Examples of control of the river flow at the site of the development are found in the Boulder Dam and Grand Coulee projects; of control at distant points, in the tributary river projects of the Tennessee Valley Authority (Fontana and Apalachia, for example).

## BASIC ARRANGEMENT OF HYDRAULIC STRUCTURES

The first steps in the design of a hydroelectric plant are carried out by the hydraulic engineer. From the basic data of the stream flow records, surveys at the proposed site, preliminary contour lines, and other information as to the storage possibilities either at or above the site, the hydraulic engineer begins to prepare alternative arrangements for the dam, the powerhouse, water channels, head pond, and tailrace. In this phase of design the hydroelectric project differs from the steam project in that it is only in the unusual case that the problems presented will parallel those existing in other cases; in other words, each hydroelectric project is a separate problem, with its own separate and distinct solutions. Among the factors to be considered are:

*Developed Head.* The power output of the hydroelectric plant roughly varies directly with the river flow (cubic feet per second) and with the effective head on the turbines. The effective head which may be developed at any site will be controlled by a number of factors, principal among which will be the economic location and height of the dam and the extent of the area to be flooded above the dam. The hydraulic engineer will study various possible arrangements, with the object of selecting the one arrangement which results in maximum output at minimum unit cost.

*River Flow Conditions.* Again because of its effect on plant output, the hydraulic designer will strive for the highest controlled river flow, which means maximum storage capacity. However, it is rarely that the storage possibilities permit the full control of the river flow. Grand Coulee is one such example, but the normal case requires the development of an economic comparison between the cost of establishing storage areas and the revenue to be derived from the increased output resulting from such storage. The Tennessee Valley Authority system contains interesting examples of some tributary developments which provide full control and others (main river developments) in which a major problem has been the provision of spillway capacity to pass extreme flood flows which the development does not control directly.

*Means of Introducing Water to the Plant.* The topography at the power site provides the hydraulic engineer with a never ending series of problems relating to the arrangement of the dam and the powerhouse and the delivery of water to the turbine water passages. In the simplest case, the powerhouse is built as part of the dam, in the natural bed of the river. More usually the powerhouse is independent of the dam and an open canal, tunnel, or pipe lines will be required to deliver the water from the head pond to the forebay above the powerhouse. In some cases, as for example at the Tennessee Valley Authority Apalachia plant, the intake tunnel is several miles in length. Once again the hydraulic engineer will develop alternative plans, from which a final economic selection may be made.

*Means of Conducting Water From the Plant.* The static head on the hydroelectric plant will be the net difference in elevation between head water and tail water. The operating head will vary as the head water is drawn down or the tail water raised, under operating conditions. It is obviously equally important to get the water away from the plant efficiently as to deliver it to the plant. The tailrace problem therefore parallels the head water problem, the two being considered jointly.

*Total Installed Capacity.* The total capacity to be installed at a given site usually is not dictated solely by the hydraulic engineer, as consideration must be given to the problems of generation, transmission, and absorption of the plant output by the system. However, the hydraulic engineer is interested in the limits of load factor for which an economical design can be derived. Generally, where long-distance transmission is involved, a high load-factor is desirable, though, where adequate pondage area (as distinct from long-term storage) can be provided immediately above the plant, operation as a "peaking" plant may be possible, particularly if the cost of the increased capacity is relatively low, including only provision for greater peak water flow and the actual equipment installation.

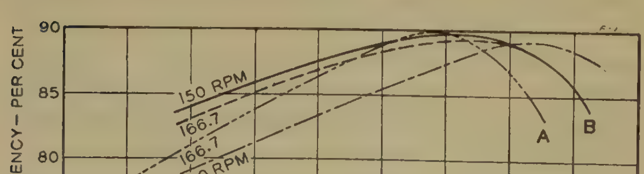



**Figure 1. Typical efficiency curves for Francis-type turbines, illustrating possible variations in the shape of the curve**

A special case is the so-called "run-of-river" plant, where storage capacity is virtually nonexistent. The problem then becomes one of deciding what proportion of the flood flow of the river can be developed economically, that is, for what proportion of the hours of the year a unit must operate to justify its installation. Where this type of plant is to be introduced into a system largely steam supplied, a clear-cut economic problem is presented.

As a result of these extensive and generally fairly preliminary studies the hydraulic engineer is able to present for further consideration a series of possible arrangements for any given power site. These will include alternatives as to rated capacity and operating load factor. They also will include variations of arrangement, and provision for such special features as navigation, fishways, flood control, and passage of water for irrigation purposes, as well as provision for electrical and operating requirements, transformer and switchyard locations, and operators' colony.

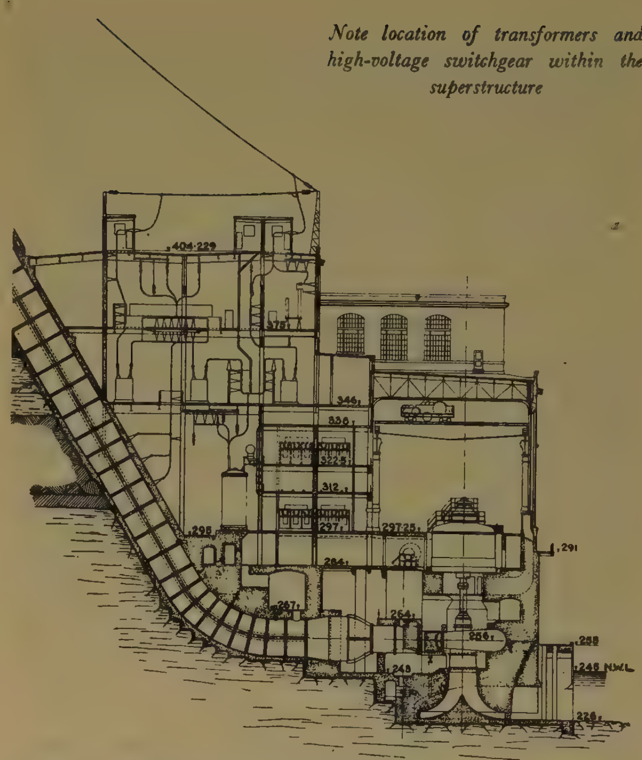



**Figure 2. Cross section of the Queenston development of the Hydro-Electric Power Commission of Ontario**

## BASIC STUDY OF SYSTEM REQUIREMENTS

The maximum load concentrations in the average utility system are in the major cities. These cities generally are located such that the cooling water requirements for steam-electric generating stations are found within short distances of the load centers. It follows, though it is recognized that this statement is oversimplified, that the metropolitan steam-electric station can be located to suit load requirements and further that it can be designed for any peak capacity and for any operating load factor consistent with the over-all economy of the system at large. These conditions usually do not apply in hydroelectric developments. Hence, the second steps in the design of additional hydroelectric generating capacity concern the fitting in of available sites to the estimated future demands of the system.

The planning division of the utility will maintain records of daily, seasonal, and annual load demands, both peak and energy. They will record carefully trends in the shape of the daily load curve and of its variations between seasons or between peak and off-peak periods of the year. They will be conversant with the operation of existing plants, the limitations of existing storage reservoirs, and the long-term variations in precipitation on the different watersheds within the system. The records of this division will include projections of load demand into future years, as accurately maintained as economic conditions permit. In general it may be stated that detailed estimates should be available for whatever period in the future would be required to add new capacity to the system, usually a period of the order of two years. Beyond such period future load estimates are indicative of possibilities only, as such estimates seldom can be considered dependable.

Where the system logically may be subdivided into major load areas, these various data similarly will be subdivided, in order that the generating capacity available in and the load demands of each area may be studied independently. In this way the peak and energy transfer requirements between areas, under both normal and possible emergency conditions, may be studied and compared with the capacity of existing interconnecting facilities.

In the system predominantly supplied from hydroelectric resources over long-distance transmission lines, a more critical analysis of kilovar distribution usually will be required than in the more compact steam-supplied system. For this reason, the system records maintained will include data as to kilovar distribution paralleling the records of kilowatt capacity and demand.

These various data provide the planning division with the means of conducting system studies, the object of which will be to determine, at any time, specifications for the new generating requirements and the most advantageous point of connection to the existing system. Under certain conditions, the new plant may be required to be capable of operation at high average load factors; under other conditions, peak capacity only may be necessary. Certain arrangements may effect a better control of voltage regulation, having regard to the distribution of the kilovar requirements. System kilovars may be supplied from three sources—unregulated capacitor installations near the load, regulated capacitor banks or synchronous condensers at load centers, or from the kilovar capacity of the generating units. These studies will indicate the answer to the problem of what proportion may be supplied economically from the new generating source, thus establishing the desirable power factor rating of the new generators.

Assuming, therefore, that more than one new site is available for development, system studies, combining technical and economic comparisons, will indicate that site which first should be developed. For this site (or

where only a given site is available) the capacity to be installed, the transmission voltage, and general system arrangement will be decided and the basic specification data established from which the detailed designs of the plant later are derived.

### HYDRAULIC TURBINE CHARACTERISTICS

The basic element in the powerhouse design in which the electrical designer is interested is the hydraulic turbine (and its associated water passages). Four types of turbines are encountered—the impulse or Pelton type in high-head plants (above approximately 800 feet), the reaction or Francis type for moderate heads (approximately 60 to 800 feet), the fixed-blade propeller type, and the adjustable-blade propeller or Kaplan type for low-head installations (below 70 feet). As the first type is not common and involves unusual considerations, such as horizontal shaft generators, it will be omitted from further discussion.

For any given plant and for a given type turbine, the developed head and the total operating capacity fixes, within rather narrow limits, the number and capacity of the generating units and also the speed of rotation. At a given speed, increasing the capacity (or, for a given capacity, increasing the speed) beyond certain well defined limits introduces the problem of runner cavitation. Here will be noted a basic difference from steam-electric plant design, where the selection of the capacity and speed is wholly in the designer's hands. When the head and capacity conditions permit a choice, approximately 50 per cent higher operating speed is obtained using the propeller type unit as against the Francis type, though the overspeed for which the generator must be designed may be nearly 300 per cent in the case of Kaplan units, as compared to approximately 200 per cent for fixed-blade propeller and 180 per cent for Francis type turbines operating at normal rated head.

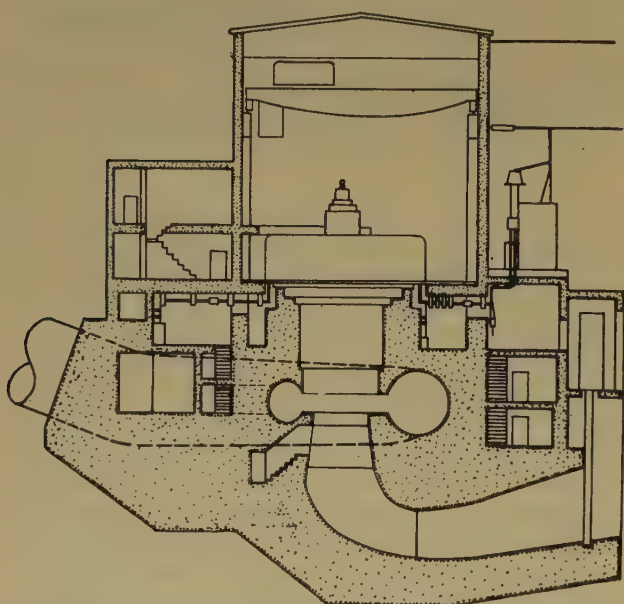


**Figure 3. Cross section of a typical moderate-head plant, with transformers located on the tailrace deck**

The electrical designer has a particular interest in the fact that hydraulic considerations control the turbine speed. The speed obviously governs the generator design and may control the spacing of units, determine the superstructure design, crane capacity, and erection bay space requirements. It is of interest to note that European practice tends toward higher speeds than are used on the North American continent. European designs permit of higher water velocities entering and leaving the turbine, velocities which hydraulic designers in North America currently consider reach into the field where cavitation becomes a major consideration. However, the continental designer may make an extensive use of stainless steel, particularly in the runner blades of propeller type units, to permit increasing the allowable cavitation factor. American designers and utility engineers are facing an interesting problem in this regard, in balancing the saving in capital cost resulting from higher speeds against the increased costs of maintenance of runners which suffer from cavitation.

The system engineer will be interested also in the plant efficiency curve. In the hydroelectric plant, the efficiency of the hydraulic design (water passages and turbine) cannot be predicted with the accuracy of, say, an electric generator design. Quite usually the draft tube design is dictated by the turbine manufacturer and at least one utility permits the manufacturer also to dictate the design of the intake passages. Model tests frequently are resorted to, to compare the efficiency of alternative arrangements or to determine what guarantees are to be submitted in a given case. Depending on the particular arrangements and characteristics selected, the turbine efficiency curve may be peaked sharply as in curve $A$ of Figure 1 or have a relatively flat section at and near maximum efficiency as in curve $B$.

If it is possible to vary the number of units operating as the total plant load varies, so that all units may be operated at maximum efficiency, a peaked efficiency curve may be acceptable. However, if the plant is to provide system regulating capacity, or if for any other reason the units may be required to operate over an extensive load range, a flatter efficiency characteristic may be desirable, even though the actual maximum efficiency be somewhat less. If the head on the plant varies over wide limits, as for example in the main river plants of the Tennessee Valley Authority, this fact may dictate the efficiency characteristics selected.

Hydraulic considerations will control one further feature of interest, namely, the flywheel effect of the generators. The turbine scroll case, penstocks, and other water passages must be designed to withstand the transient pressure rise occasioned by the rejection of load

and the subsequent rapid closing of the turbine gates. It is usual to require that this pressure rise (or the resultant overspeed of the unit) shall not exceed a specified figure, assuming gate closure in from three to six seconds, depending on the head. Unless there are special stability requirements, this specification will govern the flywheel effect which must be incorporated in the generator rotor design.

The type, rating, and speed of the turbine fixes the dimensions of the turbine water passages, which dimensions frequently govern the unit spacing in the powerhouse. The same factors control the elevation of the horizontal center line of the turbines and hence the general dimensions of the powerhouse substructure. Figures 2, 3, and 4 are cross-section drawings of three plants, illustrating some of the variations which may be introduced into the general plant arrangement by hydraulic and other considerations.

Figure 2 is a moderate head plant (approximately 300 feet), in which the turbines are Francis type. Topog-

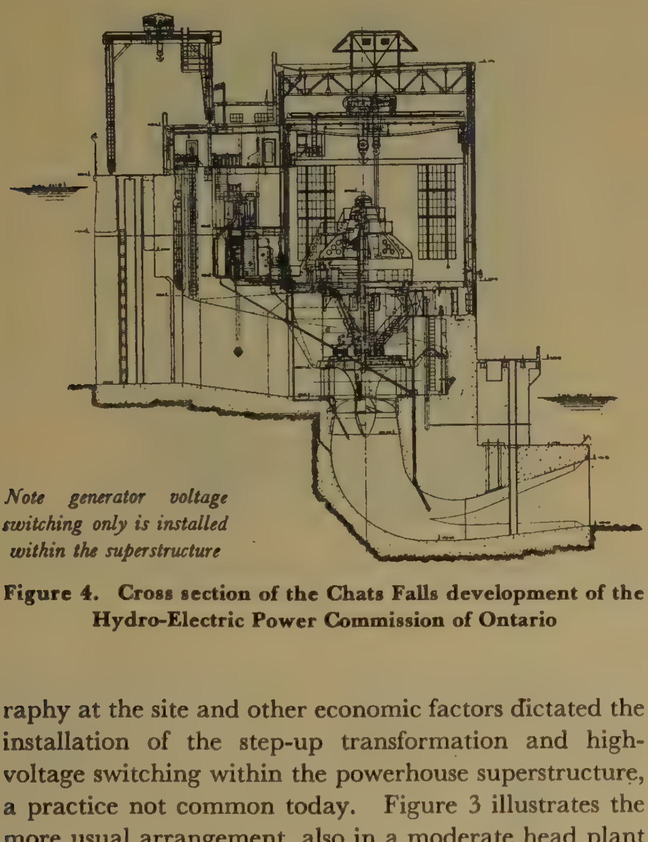



**Figure 4. Cross section of the Chats Falls development of the Hydro-Electric Power Commission of Ontario**

raphy at the site and other economic factors dictated the installation of the step-up transformation and high-voltage switching within the powerhouse superstructure, a practice not common today. Figure 3 illustrates the more usual arrangement, also in a moderate head plant with Francis turbines, where the transformation is installed outdoors on a deck above the tailrace. A long horizontal section in the turbine draft tube promotes the use of this arrangement. In other cases, the transformation may be on the upstream side of the superstructure.

Figure 4 illustrates a typical low-head plant, in which the turbines are fixed-blade propeller type. In this plant, the generator voltage switching only is installed in the powerhouse, the generator cables being taken some distance to a step-up transformer and high-voltage switching station at another location. In a development of major proportions, the electrical designer is often required to display considerable ingenuity in arranging the main electrical circuits from the frequently relatively inaccessible generators through the transformers and high-voltage switching to the outgoing transmission lines.

## GENERATORS

Hydroelectric generating units may range in capacity from 1,000 to approximately 100,000 kw. Speeds may range from less than 100 rpm to an approximate upper limit of 300 rpm (excluding Pelton type turbines). The vertical shaft arrangement is encountered most commonly, having the main thrust and upper guide bearings above and a second guide bearing below the rotor though a combination of thrust and single guide bearing below the rotor (the so-called "umbrella-type" unit) is rapidly gaining in favor. A typical 41,250-kva 109-rpm 60-cycle unit weighs 1,075,000 pounds total, the thrust bearing supporting a combined rotor and runner weight and hydraulic thrust of approximately 1,000,000 pounds. In some larger units, the thrust bearing loading exceeds 3,500,000 pounds.

*Insulation.* Hydroelectric generators are usually class *B* insulated throughout, for which class of insulation the AIEE Standards permit a temperature rise of 80 degrees centigrade above an ambient temperature of 40 degrees centigrade. However, it is not common to find utilities operating units at this temperature, it being more usual to specify that a generator shall be capable of full output at normal operating voltage with only 60 degrees centigrade rise.

*Excitation.* Generator voltages, in the larger units, are usually in the 12 kv to 15 kv range, the higher voltages occasionally found in steam-electric units not having been adopted, at least on the North American continent. Excitation, in all but the lowest speed units, is supplied from direct-connected exciters and pilot exciters. Stability being so often a factor in hydroelectric plant operation, the excitation system normally is designed for high-speed operation—the rate of exciter response is of the order of 225 volts per second. The condenser (overexcited) capacity of the typical unit would approximate 60 per cent and the line charging (underexcited) capacity 80 per cent of the normal kilovolt-ampere rating.

*Power Factor.* The power factor rating of hydroelectric generators is frequently 80 per cent lagging. However, the economic distribution of system kilovars often indicates that such a low rating is uneconomical; in fact, in cases involving high-voltage long-distance transmission lines, even a unity power factor rating may be justified. Here the naturally conservative designer is faced with a compromise between the desire to provide flexibility in the form of excess kilovolt-ampere capacity and the

possible lowering of system stability resulting from units operating underexcited. It is not uncommon to find units rated at 85 per cent to 90 per cent power factor and 95-per-cent-power-factor units were proposed in at least one development with which the author is familiar.

*Rating.* The relationship between the turbine and the generator rating in hydroelectric plants differs from standard steam practice. It is usual to provide a steam turbine whose kilowatt capacity is equal to the kilovolt-ampere capacity of the usually 80-per-cent-power-factor generator. Hydroelectric units are almost invariably "tailor-made," capacities and speeds seldom corresponding. The degree of standardization proposed for steam-electric generators therefore will be difficult to attain in hydroelectric practice. Furthermore, once the hydraulic design is established, the maximum turbine output varies only with the operating head. The generator kilowatt rating therefore is selected to equal the turbine capacity at some selected or normal head. At such times as the available operating head exceeds this rated figure, the increased turbine output may be provided for, either by operating at higher power factors or by operating at temperatures above the specified 60-degree rise but within the limits permitted by the class *B* insulation.

*Reactances.* The reactances of hydroelectric generators frequently are controlled by system stability conditions. However, low reactances mean larger machines physically and hence greater cost. The designer faces an interesting problem in balancing the desired characteristics against capital expenditure. Typical direct axis subtransient reactance would approximate 35 per cent and quadrature axis subtransient reactance 75 per cent. Short-circuit ratio normally would lie between 1 and 1.25, though in certain installations a much higher ratio has been specified.

The direct and quadrature axis reactances quoted here assume that pole face or damper windings are not present. Investigations of the past few years indicate that many previously unexplained flashovers, in systems involving long-distance transmission, result from the clearing of a single-phase-to-ground fault only at the distant end of a line, leaving the generation supplying the open-ended and still faulty line under conditions approaching resonance. Material improvement in such conditions is effected by the installation of damper windings, whereby the ratio of quadrature to direct axis subtransient reactances is reduced to less than 1.3. Such windings should be continuous to be most effective, but satisfactory designs have been devised in which the winding is noncontinuous, that is, there are no troublesome bridging sections between the poles.

*Thrust Bearings.* Two types of thrust bearings are offered by American generator manufacturers—the Kingsbury and spring-supported bearings. The thrust block and runner plate construction is similar in the two, the essential variation being in the stationary bearing surfaces.

In the Kingsbury bearing (Figure 5), the stationary bearing surface is subdivided into several segments, each of which is supported, and subject to individual adjustment, by means of a single vertical spherically headed jackscrew. Adjustment of the bearing and alignment of its surface may be carried out at the bearing itself.

In the spring-supported bearing (Figure 6), the stationary plate is essentially one piece, being split only for assembly around the shaft. This plate is supported on a nest of helical springs, arranged in a tray which is subdivided segmentally. These springs are precompressed and each is machined after compression to within a close tolerance of uniform length. The bearing surface being essentially of one piece, adjustment and alignment of this type of bearing must be effected by the adjustment of the whole bearing bracket.

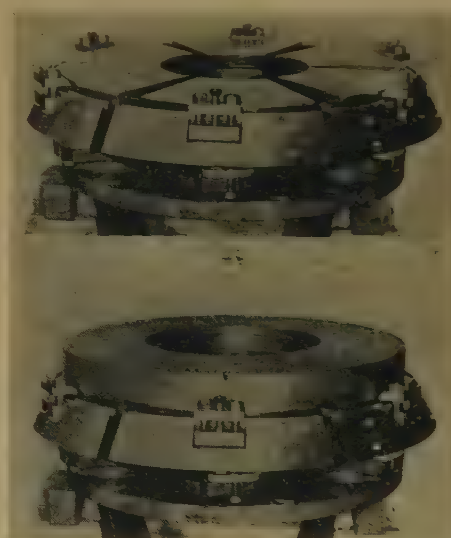


**Figure 5. Typical Kingsbury thrust bearing**

The successful operation of bearings of either type, carrying loads up to nearly four million pounds, depends on the degree of finish of the bearing surfaces, the accurate alignment of the generator and turbine shafts and the adjustment of the bearing during erection, and the maintenance of this alignment and adjustment during operation. The critical time in bearing operation is during the first few revolutions of the unit when starting up or the last few revolutions when shutting down, when the danger of there being an incomplete oil film is greatest.

*Cooling.* All older hydrogenerators were of open construction, self-cooled by the fanning action of the rotor, the oldest units taking air from and discharging air into the powerhouse. Later designs provided duct

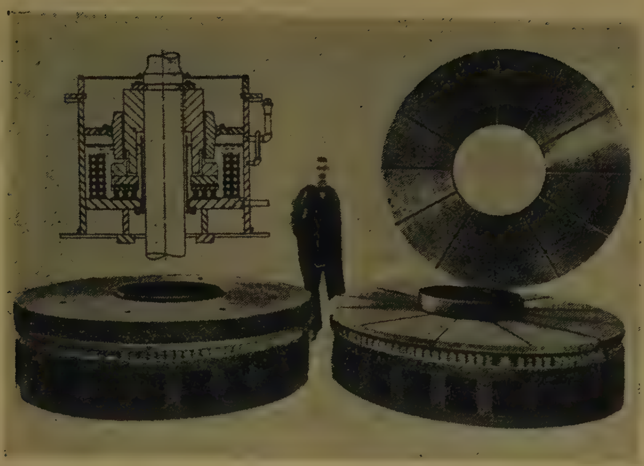


**Figure 6. Typical spring-supported thrust bearing**

systems, in some of which air could be taken from outside the powerhouse and discharged into the powerhouse and in some of which the reverse arrangement was provided. Again later, more complete duct systems provided both an air intake and discharge outside the powerhouse. Damper arrangements were then possible for the control of generator temperature and for the operation of carbon-dioxide protection.

Modern designs follow turbogenerator practice in totally enclosing the generator stator, cooling being by means of surface coolers incorporated within this housing. The saving in cleaning costs usually will go far towards justifying the increased cost of this design, but its greatest advantage accrues from the possibility of controlling the operating temperatures to a more nearly uniform level, a condition highly effective in prolonging the life of armature insulation.

## TRANSFORMERS

The step-up transformation in hydroelectric generating stations is of generally standard design. Water-cooled units perhaps are used more frequently than elsewhere, because of the availability of cooling water, sometimes taken directly from the penstocks under natural head. A variation, which has found less favor than it appears to deserve, is forced-oil cooling with the cooling equipment suspended in the tail water. With a positive oil pressure, leaks need not be feared and the maintenance problems incidental to screening the water supply or cleaning out the cooling system substantially would be avoided.

Three-winding transformers, having two low-voltage windings of one-half capacity and a single high-voltage winding of full capacity, have been adopted in a number of stations, particularly where the higher transmission voltages are employed. Pairs of generating units are connected to each transformer bank. This arrangement stems from the fact previously mentioned, that the unit capacity is determined by hydraulic considerations, whereas the capacity of the transformer bank is limited only by manufacturing and transportation requirements. Such an arrangement effects a definite saving in transformer cost and also a further indirect saving in the high-voltage switching.

## MAIN ELECTRICAL CONNECTIONS

As a general statement, it probably may be said that the main electrical connections in the hydroelectric generating station are more simple than in the steam-electric station or main transformer center. The primary problem is to establish as simple an arrangement of switching as will permit the delivery of the output of the generating units to the transmission lines, with the required degree of flexibility in meeting the anticipated normal and emergency operating conditions. This problem will vary in complexity depending upon whether the output of the station is to be delivered to a single load center or whether several groups of units must be connected flexibly in a number of subsystems. In special cases, as for example in stations of the magnitude of Grand Coulee or the proposed St. Lawrence development, the selection of the main electrical diagram may have an important bearing on the system stability conditions.

Personal preferences combine with the operating requirements and economic factors in influencing the final choice of diagram. Some designers prefer the simplicity and low cost of the ring arrangement; others prefer the double bus layout with its greater flexibility at greater cost. With high transmission voltages, an appreciable saving may be effected by the elimination of high-voltage switching, though high voltages usually are associated with greater capacities, so that even generator voltage switching may become a difficult and costly alternative. Nevertheless, there appear to be two distinct trends, one towards concentration on high-voltage switching only and the other toward a similar concentration on low-voltage switching only.

Figure 7 illustrates four types of station diagram using high-voltage switching only. Diagram (a) is the familiar ring diagram, which most system designers would adopt only if the number of breakers required is relatively small. Diagram (b) is a form of diagram adopted as standard by the Tennessee Valley Authority. This diagram has certain disadvantages from the flexibility standpoint and also may introduce complications in the control and protective system.

These disadvantages may be eliminated progressively by an increased number of breakers and corresponding greater cost. Diagram (c) is a so-called "breaker and a half" scheme, which can satisfy rather exacting requirements of system operation, while diagram (d) is the ultimate double-breaker arrangement.

Two diagrams illustrating the elimination of high-voltage switching are shown in Figure 8. Diagram (a) utilizes a ring bus at generator voltage, with the trans-

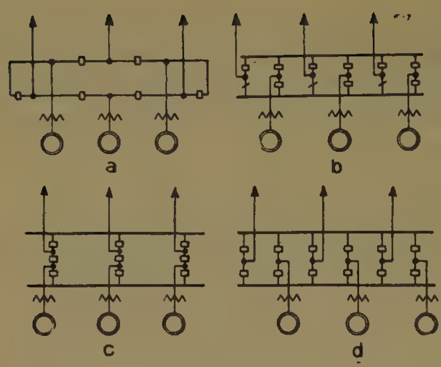



**Figure 7.** Main station diagrams using only high-voltage switching

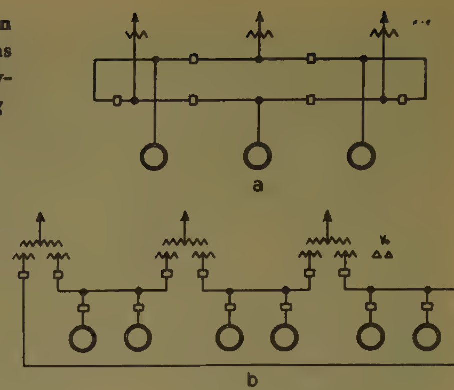



**Figure 8.** Main station diagrams using only low-voltage switching

former banks directly in the high-voltage lines. Diagram (b) is a form of diagram proposed for at least two major developments on the North American continent.[1] Both these diagrams, it will be noted, involve the loss of a transformer bank coincidental with a line outage. If the output of the plant is not to be reduced and the system is to remain stable under such conditions (as normally would be required), excess capacity must be provided in all transformer banks, the total of which must equal the capacity which would be lost under an emergency condition. Such excess capacity might be provided by normally operating with rated water circulation or without blowers, increasing the circulating water, or placing the blowers automatically into service during line outages.

*Low-Voltage Switching.* Switching equipment for generator voltages currently is almost invariably of metalclad construction. While many installations are of oil circuit breakers, air-blast equipment is gaining in favor and it would appear that the indoor installation of such equipment, in metalclad structures, provides an excellent solution to the electrical designer's problems.

*High-Voltage Switching.* Equipment of standard design meets all the requirements of the hydroelectric plant. Circuit breaker speeds would be a function of the system conditions, normal or ultrafast operation being dictated by stability requirements. Automatic reclosure may be applied and single-phase operation may be quite effective, as in many other points in the utility system.

## CONTROL

The arrangement of the control, metering, and protective relay equipment in hydroelectric plants is not materially different from that in the modern steam station. The control room is most frequently in a location remote from the main generator floor and will be soundproof, air-conditioned, and indirectly lighted in plants of recent design.

A number of small (and some moderate) capacity plants have been arranged for fully automatic operation—going into service or shutting down without manual attendance, either by push-button control from a supervisory center or under pre-established conditions of system load, frequency, or head water level. Automatic synchronizing, of even the largest units, is becoming standard practice in most utilities.

Automatic load and frequency control is applied in hydroelectric plants as an accepted adjunct to present-day standards of system operation. Where the head water level is required to be held within definite limits, water level control may be combined with the other automatic features.

One feature of control peculiar to hydroelectric development is that of depressing the water in the turbine draft tube to permit operation of the generating unit either as a synchronous condenser or as a unit in spinning reserve. Operation of a unit at part load, in order to utilize the remaining kilovolt-ampere capacity for power factor control, results in inefficient water utilization. If the turbine is set above operating tail water level, closing the turbine gates and breaking the vacuum in the draft tube permits the operation of the unit free of the water drag. When the unit is set below tail water level, compressed air connections may be provided to force the tail water below the runner blades and to maintain this condition during synchronous condenser operation.

This feature has been applied extensively in the plants of the Tennessee Valley Authority where the system conditions are such as to make it of particular value. At certain seasons, while water is being stored, the power output of the eastern (up-river) plants is low and heavy west-to-east transmission line loadings occur. Units in the easterly plants then may be used, with depressed tail water, for voltage control. During dry periods, when storage water is being released, the reverse condition applies and the westerly (down-river) plants may supply the required kilovar capacity. Control is such that units operating as synchronous condensers will return automatically to generator operation in the event of a slight drop in system frequency.

## STATION SERVICE AND AUXILIARIES

The station service connections and auxiliary systems in the average hydroelectric plant are much more simple than in its steam counterpart, due to the absence of coal handling, circulating water, boiler plant auxiliaries, and

draft fans. The major service requirements include head gate control, governor pumps, transformer and generator cooling water, lubricating oil and compressed air systems, and cranes and unwatering pumps, together with the usual lighting, heating, ventilating and sanitary requirements, and machine shop and maintenance facilities.

Continuity of service power supply, however, is of

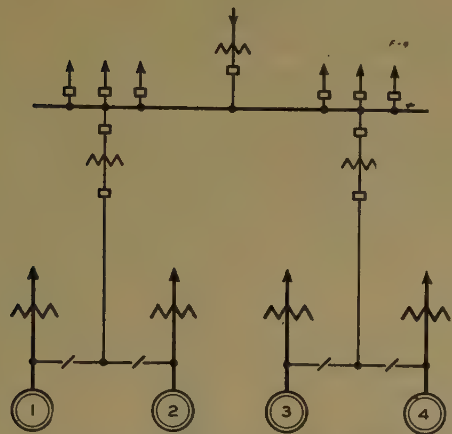



**Figure 9. Schematic diagram for station service power connections in a multiunit plant**

equal importance. Usually two sources of service power are arranged—in a multiunit plant taken from the generator-transformer leads as is illustrated in Figure 9. A third source may be from an outside system connection. This latter source may be of only nominal capacity, to provide for those services essential to returning the plant to service after a complete shutdown. As a variation, where generator voltage switching is absent, the main service connections may be through transformers stepping down from the high-voltage bus.

Governing requirements in the hydroelectric plant differ from those in the steam-electric station because of the inertia of the moving mass of water. Governor heads in older plants are driven mechanically from the main shaft of the unit—in later plants, electrical drive is more common, either from potential transformers connected to the generator leads or by means of a permanent-magnet generator attached to the main shaft. In some plants, a separate system is provided for the governor fluid; in others, the same oil is used for governor operation as for bearing lubrication. An interesting development in governor practice is seen in the Apalachia plant of the Tennessee Valley Authority, where the governor cabinets are installed in the control room, thus combining all control in the one location, which also, incidentally, is on the main generator floor level.

Circulating cooling water will be limited to that required for the turbine and generator bearings, for the water-cooled transformers, if present, and for generator cooling, where totally enclosed water-cooled generators are used.

The compressed air system will supply service air, the generator brakes, and the tailwater depressing system where used. All hydroeletcric generators are equipped with air brakes, the application of which usually is controlled by the governor during both normal and emergency shutdowns. Most designers prefer that the air system for the generator brakes be independent of the station service air, so as to insure its availability at all times.

It is impossible to present details of design within the space limitations of this article. These matters, however, have been treated extensively in AIEE papers and in other technical literature.


REFERENCE

1. **Three-Winding Transformer Ring-Bus Characteristics, G. W. Bills, C. A. MacArthur.** AIEE *Transactions*, volume 61, 1942, December section, pages 848–9.


## Electrical Essays

THIS electrical essay is presented for the recreation of the reader. Can you find the error in the following reasoning?

A capacitance $C$ charged to a voltage $E$ suddenly is connected in parallel with another equal capacitance which is initially uncharged. If negligible inductance in the circuit is assumed, the pair of capacitors should assume almost instantly a potential difference of $E/2$ since the initial charge now will be divided equally between the two capacitors.

If the resistance also is assumed to be negligibly small, this change should take place with no appreciable loss of energy. However, the initial stored energy was $1/2CE^2$, and the final combined stored energy of the two capacitors is

$$2\left[\frac{1}{2}C\left(\frac{E}{2}\right)^2\right]$$

or

$$\frac{1}{4}CE^2$$

Can it be that the law of conservation of energy fails to hold in this case? What is wrong?

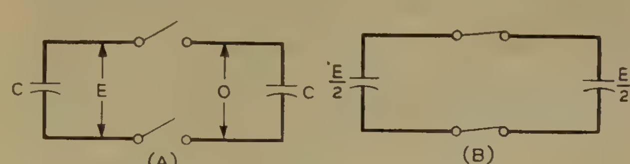



**Figure 1**

A. $\frac{1}{2}CE^2+0=\frac{1}{2}CE^2$ B. $\frac{1}{2}C\left(\frac{E}{2}\right)^2+\frac{1}{2}C\left(\frac{E}{2}\right)^2=\frac{1}{4}CE^2$

# Power Plants for Airplanes

AVIATION PROGRESS throughout its history has been paced by the development of airplane engines. The constant trend has been toward bigger and faster airplanes, consequently toward more powerful engines. Until recently, airplanes were driven only by reciprocating internal-combustion engines. Now there are new power plants and of them, two likely will figure in aviation of the near future. One of them is the jet propulsion engine; the other is the gas turbine–propeller drive. Both will have continuous combustion gas turbines as the prime mover.

**Gas turbines as power plants for airplanes now are providing competition for the highly developed reciprocating engine. They may utilize only the thrust of the exhaust gases as a jet engine, drive a conventional propeller, or combine the two actions. Comparison of the three reveals their relative advantages and fields of application.**

While the reciprocating engine undoubtedly will continue to hold its present position in the field of low power and for planes of low speed, the gas turbine will come into its own both as a jet engine, and for driving propellers in high-powered planes and for high-speed flight.

Of the three types of power plants, the gas turbine–propeller engine has characteristics that give it superiority over the reciprocating engine in all speed ranges and over the jet engine in low and intermediate speeds. The jet is pre-eminent in the highest speed range. Figure 1 shows the probable fields of use of the three types. These conclusions are reached by comparing the performances of airplanes in which each of the three types of engines might be installed.

## THE RECIPROCATING ENGINE

The primary objectives of efficiency, light weight, and reliability have been met by the reciprocating engine. However, power ratings have reached a point where further major increases probably can be attained only by improvements in fuels or the addition of cylinders. The diameter or frontal area of engines already is limited by allowable piston speeds, larger engines are longer engines, and the specific weight is more likely to increase with power rating than decrease. Engines capable of delivering several thousand horsepower require controls, accessories, and exhaust-disposal systems which complicate installation and maintenance problems to an extent that limits further large increases in power rating. The reciprocating engine by nature is adapted to cruising flight rather than sustained high-speed flight. Its highest efficiency and greatest reliability are achieved only when the engine is operated below 60 per cent of rated power. An underpowered airplane is plagued constantly by power-plant troubles of a mechanical nature.

## THE GAS TURBINE–JET ENGINE

In jet propulsion, all the power output of the engine is used to accelerate the air taken into the engine to a jet of approximately acoustic velocity which is expelled through an exhaust nozzle. The resultant thrust felt by the engine housing is the reaction to the force required to accelerate the intake air to its exhaust velocity. The gas turbine operates by inducting air, compressing it, adding heat at high pressure, and expanding the high-temperature combustion products. The major part of the energy is recovered in expansion through the turbine blading and must be used to supply energy required for compression. The remainder of the expansion can be made to take place through a nozzle, where the energy appears as kinetic energy of the exhaust gases.

Principal advantages of the jet engine are its simplicity and light weight. The installed weight of the jet-propulsion engine is little higher than its dry weight, since little oil is required for lubrication, and the engine itself requires no external cooling provisions. The jet engine's

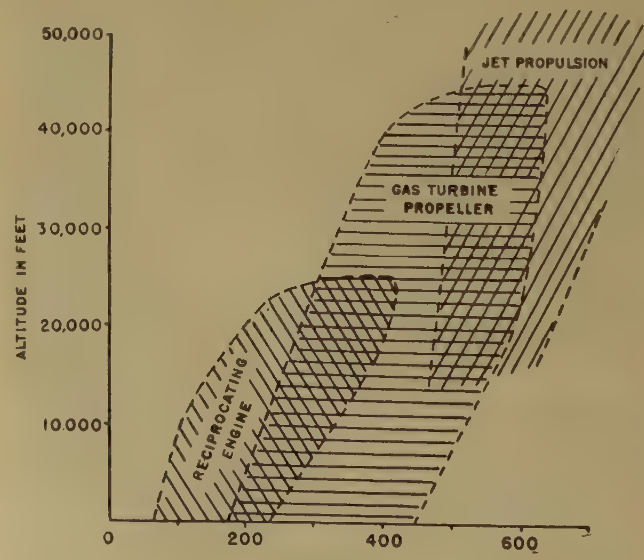



**Figure 1. Probable fields of use of the three types of aircraft power plants of the near future**

Extracted from "The Place of the Gas Turbine in Aviation" by Charles D. Flagle, design engineer in the aviation gas turbine division of the Westinghouse Electric Corporation, South Philadelphia, Pa., and Frank W. Godsey, Jr. (M '36) manager of the new products division of the same company at East Pittsburgh, Pa.

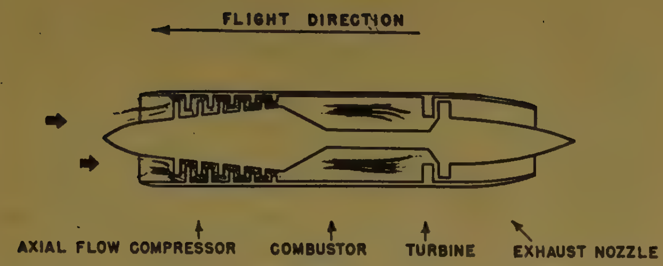



**Figure 2. Schematic illustration of an aircraft jet propulsion engine with axial flow compressor and in-line combustor and turbine**

thrust is relatively constant over normal airplane speed ranges. Therefore, the rating of a jet engine usually is given in terms of thrust rather than horsepower and means nothing from a power standpoint until the speed also is given. A thrust of one pound at a speed of 375 miles per hour is equivalent to one horsepower; at lower speeds the power rating decreases and at higher speeds it increases in direct proportion.

An adjustable-pitch propeller is capable of converting shaft power into thrust horsepower rather efficiently over a wide range of airplane speeds, but the jet engine's efficiency is quite low at low speeds. Below 500 miles per hour the jet efficiency, and consequently its fuel economy, are inferior. The fuel efficiency of a jet engine is low because of the jet efficiency characteristic and because the gas turbine itself operating at a low-compression ratio is handicapped in efficiency.

It is significant to note that jet efficiency overtakes propeller efficiency in a speed range in which compressibility effects impose critical aircraft-design limitations. Much aerodynamic research must be carried out before jet propulsion can be utilized to its best advantage.

## THE GAS TURBINE–PROPELLER DRIVE

A simple open-cycle gas turbine can be built today to work at a peak temperature (temperature of gases entering the turbine) of 1,500 degrees Fahrenheit. With further metallurgical progress, the life of highly stressed turbine parts operating under high temperature will be increased and the limiting-cycle temperature may be elevated above 1,500 degrees. With a compression ratio of ten to one and compressor and turbine efficiencies of 85 per cent, a fuel efficiency of 26 per cent can be achieved. By increasing compressor efficiency to 87 per cent and turbine efficiency to 89 per cent a rise in efficiency to 28 per cent at standard sea level conditions can be expected. At 15,000 feet, due to low ambient temperatures, the cycle efficiency rises to 31.5 per cent.

The efficiency of a gas turbine is highest at its rated load and rated speed. As speed decreases, the efficiencies of compression and expansion drop off and the compression ratio also decreases rapidly. Since the useful power output of the machine is the relatively small difference between the power developed by the turbine and power absorbed by the compressor, any change in compressor or turbine efficiency is magnified in its effect on power output.

The gas turbine for propeller drive operates on four to eight times the quantity of air used by a reciprocating engine of comparable power. A large exhaust jet thrust is available to supplement the propeller, since normally about 20 per cent of the useful power remains in the exhaust gases as kinetic energy; the proportion of useful power remaining in the exhaust to power delivered to the propeller can be controlled by the designer. In general, operations at normal flight altitudes are favorable to economical turbine performance. For rough approximation, the exhaust jet thrust just about compensates for propeller losses and nacelle and cooling drag, so that the shaft power output of the turbine is just about equal to the net thrust horsepower available. This is very different from the reciprocating engine.

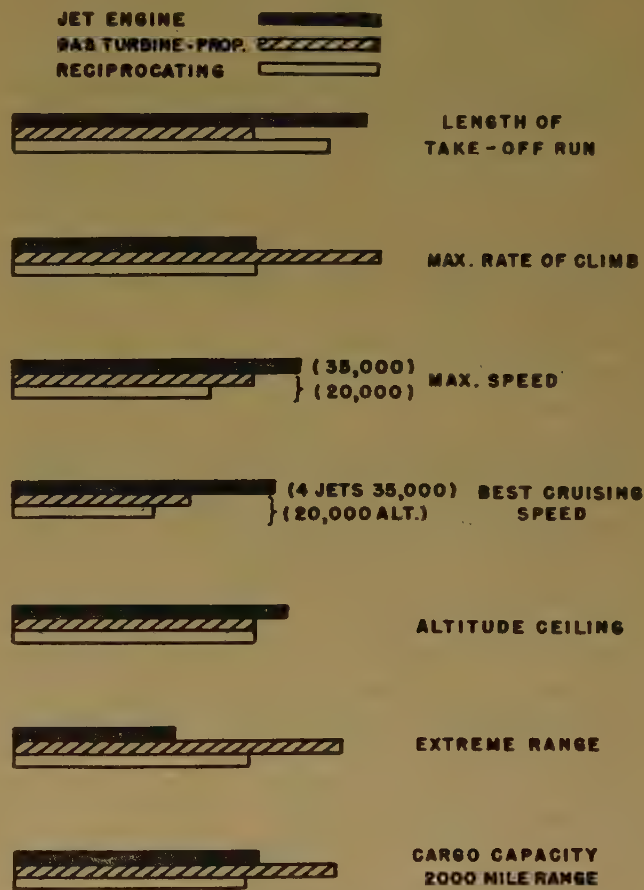



**Figure 3. General comparisons of the characteristics of three types of airplane power plants**

The gas turbine is not a supercharged engine. Therefore, the selection of power rating must be based on altitude requirements; and for sea level operation, considerable excess power usually will be available.

THE AIRPLANE AND THE POWER PLANT

The reciprocating engine, in its normal cruising power range, is a very efficient means of converting fuel energy into shaft power. However, its application to aircraft is complicated by many difficult problems, among which are the necessity for supercharging at high altitudes, severe vibration, excessive weight installed as compared with dry engine weight, and high nacelle drag and engine cooling power losses. For medium range and long range aircraft, the most important problems are probably the reduction of nacelle drag and engine cooling losses. Airplanes designed for low speed operations can afford to have a large part of the airplane's parasitic drag absorbed in engine nacelle and engine cooling losses, since induced drag may be a large portion of the total flight power requirement and engine losses are a relatively minor factor. Large reductions have been made in propeller losses in recent years, and also in nacelle and cooling drags, which may be attributed principally to nacelle design improvements and the use of engine cooling fans on radial engines. It is reasonable to suppose that further reductions will be made in the future, particularly for specialized applications such as high altitude, high speed flight. Until such improvements are made, high speed operations will be limited by power plant rather than airframe whenever reciprocating engines are used.

The axial flow jet engine (Figure 2) is a slender package capable of delivering almost constant thrust at all speeds from takeoff to dive maximum. Throughout this speed range, fuel is burned at practically a constant pounds per hour rate, and changes in speed have but little effect on thrust or fuel consumption. Further, the jet propulsive efficiency is approximately proportional to speed. These factors will lead to the use of jet engines in high speed aircraft. At low air speeds, fuel consumption rates are exorbitant when compared with propeller driven aircraft. To offset the disadvantage of low efficiency at low speeds, the jet engine delivers a lot of power for very low installed power plant weight in its proper flight speed range; cycle efficiency, while not good, is fair which means low fuel cost per thrust horsepower at very high speeds, and the engine's diameter is small enough to permit buried installations in the wings of any but the smallest planes.

The gas turbine geared to a propeller has the advantages of the jet engine with respect to drag reduction and ease of installation, while at the same time retaining the high propulsive efficiency of the propeller at low speeds. The present limit of usefulness of the geared propeller turbine at high flight speeds is set by the characteristics of available propellers which lose quite rapidly in efficiency above 500 miles per hour. The principal and immediate advantage of the geared propeller gas turbine is a large reduction in airplane drag.

It is possible to make a choice of the division of power outputs of a turbine propeller unit between jet exhaust thrust and the propeller shaft. For example, for a very high speed airplane that must have a good takeoff characteristic, 50 per cent of the power might be used in jet thrust and the remainder in the propeller. For ordinary applications, however, between 20 per cent and 25 per cent of the available energy should remain in the exhaust jet, the turbine shaft recovering the remainder. Thus, most of the energy is absorbed by the propeller with excellent over-all power plant performance at low flight speeds, and with fuel economy at high power levels that is quite superior to the conventional power plant. The field of usefulness of the gas turbine with propeller then extends to all aircraft requiring engines of greater than perhaps 1,000–2,000 horsepower and designed for all speeds up to and in excess of 500 miles per hour.

The general characteristics of the three airplanes are compared by the bar charts of Figure 3. The gas turbine–propeller airplane is superior to the conventional aircraft on every count with the exception of altitude ceiling, where they are about equal if the reciprocating engines are turbosupercharged. Because turbine propeller fuel economy and installed power plant weights are both superior to those of the conventional engine, the long range and short range load carrying abilities of the turbine propeller aircraft are superior to the conventional one. The jet propelled aircraft has a very light power plant installation and can get off the ground for very short flights with about five tons more payload than the conventional aircraft, and about three tons more than the turbine propeller version, but requires so much more fuel than other types that at about 2,000 miles extreme range the jet plane loses out to the reciprocating engine and is far behind the geared turbine in payload carrying ability.

**Figure 4 (right). Flight and propulsion spectrum**

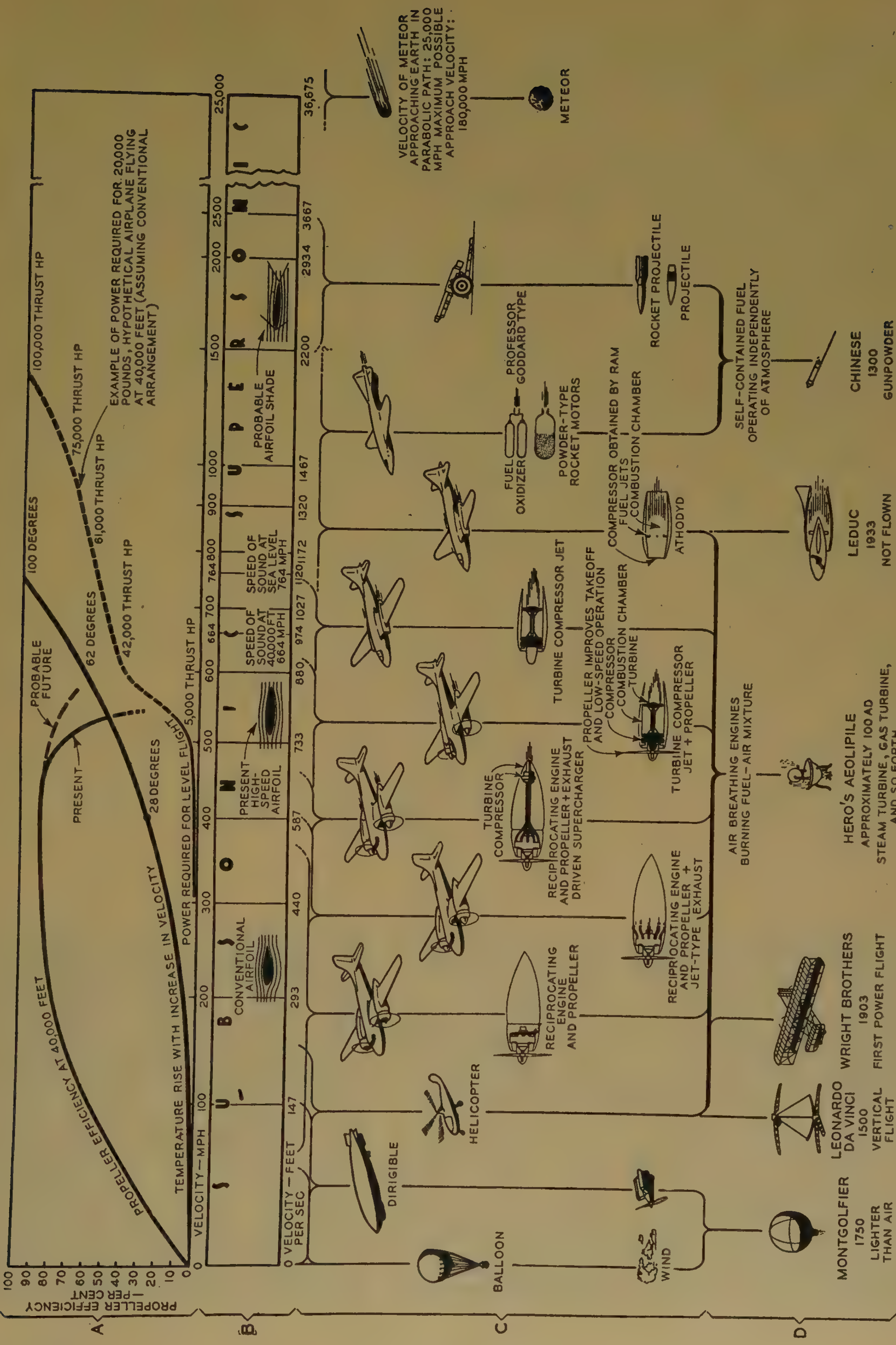
In section *A* curve of propeller efficiency shows limitations of propeller driven aircraft, which approximate 500 miles per hour, and leads to the conclusion that jet propulsion will be required for greater speeds. Second curve illustrates how temperature of a body traveling in earth's atmosphere increases with velocity and shows necessity either of employing a system of cooling or operating at higher altitudes where effective heat rise is less. Third curve illustrates presently insurmountable problem of attaining velocities of 600 miles per hour or greater with a propeller driven conventional 20,000-pound airplane flying at 40,000 feet

Section *B* illustrates probable evolution of high speed airfoils. That on right of spectrum, although suitable for these speeds, presents the problem of obtaining low speeds for landing

Section *C* shows evolution of flight in earth's atmosphere, from the slowest, the free balloon, to the fastest, the meteor. Between these two, flight can be placed in three groups:

1. Lighter-than-air ships
2. Heavier-than-air craft powered by air-breathing engines with propellers or by air-breathing jet engines with no propellers
3. Non-air-breathing rockets, projectiles

In section *D* is shown the simple origin of many present and future principles of aviation


A
PROPELLER EFFICIENCY — PER CENT
100 90 80 70 60 50 40 30 20 10 0
PROPELLER EFFICIENCY AT 40,000 FEET
PRESENT
PROBABLE FUTURE
TEMPERATURE RISE WITH INCREASE IN VELOCITY
28 DEGREES
62 DEGREES
100 DEGREES
POWER REQUIRED FOR LEVEL FLIGHT
5,000 THRUST HP
42,000 THRUST HP
61,000 THRUST HP
75,000 THRUST HP
100,000 THRUST HP
EXAMPLE OF POWER REQUIRED FOR 20,000 POUNDS, HYPOTHETICAL AIRPLANE FLYING AT 40,000 FEET (ASSUMING CONVENTIONAL ARRANGEMENT)
VELOCITY—MPH
0 100 200 300 400 500 600 664 700 764 800 900 1000 1500 2000 2500 25,000
B
SUBSONIC SUPERSONIC
CONVENTIONAL AIRFOIL
PRESENT HIGH-SPEED AIRFOIL
SPEED OF SOUND AT 40,000 FT 664 MPH
SPEED OF SOUND AT SEA LEVEL 764 MPH
PROBABLE AIRFOIL SHADE
0 VELOCITY — FEET PER SEC
147 293 440 587 733 880 974 1027 1120 1172 1320 1467 2200 2934 3667 36,675
C
BALLOON
DIRIGIBLE
HELICOPTER
RECIPROCATING ENGINE AND PROPELLER
RECIPROCATING ENGINE AND PROPELLER + JET-TYPE EXHAUST
TURBINE COMPRESSOR
RECIPROCATING ENGINE AND PROPELLER + EXHAUST DRIVEN SUPERCHARGER
PROPELLER IMPROVES TAKEOFF AND LOW-SPEED OPERATION
COMPRESSOR
COMBUSTION CHAMBER
TURBINE
TURBINE COMPRESSOR JET + PROPELLER
TURBINE COMPRESSOR JET
COMPRESSOR OBTAINED BY RAM
FUEL JETS
COMBUSTION CHAMBER
ATHODYD
FUEL
OXIDIZER
PROFESSOR GODDARD TYPE
POWDER-TYPE ROCKET MOTORS
ROCKET PROJECTILE
PROJECTILE
VELOCITY OF METEOR APPROACHING EARTH IN PARABOLIC PATH: 25,000 MPH MAXIMUM POSSIBLE APPROACH VELOCITY: 180,000 MPH
METEOR
WIND
AIR BREATHING ENGINES BURNING FUEL-AIR MIXTURE
SELF-CONTAINED FUEL OPERATING INDEPENDENTLY OF ATMOSPHERE
D
MONTGOLFIER 1750 LIGHTER THAN AIR
LEONARDO DA VINCI 1500 VERTICAL FLIGHT
WRIGHT BROTHERS 1903 FIRST POWER FLIGHT
HERO'S AEOLIPILE APPROXIMATELY 100 AD STEAM TURBINE, GAS TURBINE, AND SO FORTH
LEDUC 1933 NOT FLOWN
CHINESE 1300 GUNPOWDER

# INSTITUTE ACTIVITIES

## North Eastern District Meeting to Be Held in Buffalo, April 24-26

The Niagara Frontier Section will be host to a three-day meeting of the North Eastern District and Student Branch convention to be held in Buffalo, N. Y., April 24–26, 1946. Meeting headquarters will be in the Hotel Statler. As this is the first postwar meeting of the District, the local committee has arranged an exceptionally complete program of both professional and social events, together with inspection trips, to make the meeting an outstanding one.

TECHNICAL SESSIONS

During the three days of the meeting, eight technical sessions will be held on the following timely subjects: power systems, transmission and distribution, electronics, aircraft, industrial applications, aircraft and transportation, lighting, and communication and war developments. In addition, there will be a conference on quality control and a student conference and technical meeting, at which papers will be presented by the students.

INSPECTION TRIPS

At the conclusion of the technical sessions on Friday afternoon inspection trips will be made to power stations and industries, where the equipment which was described in the papers may be seen in operation. Among the places to be visited are the Cornell Aeronautical Laboratory at the Curtiss-Wright Plant, Huntley Station, Schoelkopf Station, one of the aircraft plants, and the Bethlehem Steel Plant.

ENTERTAINMENT

On Wednesday evening a social hour and informal banquet will be held in the ballroom of the Hotel Statler and on Thursday evening the dinner and smoker will be held. There will be an opportunity for dancing every evening. A luncheon for the women has been arranged for Wednesday to be followed on Thursday afternoon by a visit to Niagara Falls and dinner. With travel by car again possible a large turnout of women is expected.

HOTEL RESERVATIONS

Members should make their own hotel reservations by writing directly to the hotel preferred. For convenience a room reservation card for the Statler Hotel was sent to members within the District. In Table I are the rates for the Statler Hotel and also for several of the other nearby hotels.

**Table I. Hotel Rates**

| Hotels | Single Rooms | Double Rooms |
|---|---|---|
| Statler, Headquarters Hotel | \$3.30–\$6.60 | \$5.50–\$11.00 |
| Lafayette | 3.50 up | 4.50 up |
| Touraine | 3.00 up | 5.00– 7.50 |
| Buffalo | 2.50– 4.00 | 4.00– 8.00 |
| Sheraton | 3.00– 3.50 | 5.00– 6.00 |
| Ford | 1.50– 2.50 | 2.50– 5.00 |

Make reservations at once! Other meetings on the same date will tax hotel accommodations.

ADVANCE REGISTRATION

Please register in advance. This will assist the registration committee and save time on arrival at the meeting. A registration fee of two dollars will be charged all nonmembers with the exception of En-

### Future AIEE Meetings

**South West District Meeting**
San Antonio, Tex., April 16–18, 1946

**North Eastern District Meeting**
Buffalo, N. Y., April 24–26, 1946

**Southern District Meeting**
Asheville, N. C., May 14–16, 1946

**Summer Convention**
Detroit, Mich., June 24–28, 1946

**Pacific Coast Convention**
Seattle, Wash., in week of August 26–30, 1946

**Great Lakes District Meeting**
Fort Wayne, Ind., September 25–27, 1946

**Kleinhans Music Hall (left) and the City Hall in Buffalo, N. Y., where the North Eastern District meeting is being held**

## Technical Program and Meeting Features

● **PAMPHLET reproductions of authors' manuscripts of the numbered papers listed in the program may be obtained as noted in the following paragraphs.**

● **ABSTRACTS of numbered papers appear on pages 174–5 of this issue.**

● **PRICES and instructions for procuring advance copies of these papers accompany the abstracts. Mail orders are advisable, particularly from out-of-town members, as an adequate supply of each paper at the meeting cannot be assured. Only numbered papers are available in pamphlet form.**

● **PAPERS regularly approved by the technical program committee ultimately will be published in "Transactions"; many will appear in "Electrical Engineering."**

### Wednesday, April 24

**8:30 a.m. Registration**

**9:30 a.m. Power Systems**

46-99 ACO.♯ A 1,000-Kva Mobile Substation and Its Service Record. **M. W. Bardwell**, Central New York Power Corporation

CP.* Electrical-Mechanical Features of Jennison Steam Generating Station and Transmission-Line Connections. **W. W. Perry, Walter Greacen, III**, New York State Electric and Gas Corporation

CP.* Southeast Emergency and Power Pooling in 1941. **C. W. Mayott**, The Hartford Electric Light Company

CP.* Automatic Control of Large Synchronous Condensers. **M. J. Brown**, Westinghouse Electric Corporation

**12:00 noon. District Executive Committee Luncheon**

**1:00 p.m. Ladies' Luncheon**

**2:00 p.m. Transmission and Distribution**

46-100 ACO♯. Control of Frequency and Tie-Line Loads on the Niagara–Hudson System and Interconnections. **B. S. Rice**, Buffalo Niagara Electric Corporation

DP.** Theoretical Approach to Tie-Line Frequency Control. **R. Brandt**, New England Power Company

46-93 ACO.♯ Incremental Transmission-Line Losses. **W. P. Wilder**, Buffalo Niagara Electric Corporation

CP.* Primary and Secondary Cable Developments. **R. B. McKinley**, General Electric Company

46-84. Geometric Mean Distances for Rectangular Conductors. **H. B. Dwight**, Massachusetts Institute of Technology

**2:00 p.m. Electronics**

46-88 ACO.♯ Application of the Electronic Oscillator to Measurement and Control. **P. M. Hackett**, E. I. duPont de Nemours and Company, Inc.

DP.** One-Millionth-Second Radiography and Its Application. **C. M. Slack**, Westinghouse Electric Corporation

DP.** High Vacuum Leak Testing with Mass Spectrometer. **W. G. Worcester, E. G. Doughty**, General Electric Company

CP.* Induction and Dielectric Heating. **Kennard Pinder**, E. I. duPont de Nemours and Company, Inc.

**6:00 p.m. Social Hour and Banquet**

### Thursday, April 25

**9:30 a.m. Aircraft**

46-85 ACO.♯ Electric Equipment for Cornell Variable-Density Wind Tunnel. **C. C. Clymer, M. A. deFerranti**, General Electric Company

46-86 ACO.♯ Electric Equipment Required in the Modern Six-Component Wind-Tunnel Balance System. **H. O. Cox**, Cornell Aeronautical Laboratory

46-87 ACO.♯ Radio-Telemetering for Testing Aircraft in Flight. **C. L. Frederick**, Cornell Aeronautical Laboratory

CP.* Dive Testing Aircraft by Radio Control. **R. M. Stanley, R. H. Frost**, Bell Aircraft Corporation

**9:30 a.m. Industrial Applications**

46-92 ACO.♯ A Hot-Strip-Mill Flying-Shear Control Providing an Electric Tie Between Mill and Shear. **J. E. Sowers**, Bethlehem Steel Company; **V. A. Leitzke**, General Electric Company

CP.* Spectrograph Analysis of Steel. **T. S. Jackson**, Bethlehem Steel Company

DP.** Arc Furnace Switching. **L. W. Long**, Allis-Chalmers Manufacturing Company

DP.** Theoretical Conditions Existing in Single-Phase Electric-Furnace Circuits. **J. J. Pannabaker**, Vanadium Corporation of America

**12:00 noon. General Luncheon**

Address: Organization of Engineering Profession. **W. S. Hill**, General Electric Company

**2:00 p.m. Ladies' Visit to Niagara Falls, followed by Dinner**

**2:00 p.m. Aircraft and Transportation**

CP.* Automatic Instrumentation for Recording Flight-Test Data. **E. T. McMahon**, Bell Aircraft Corporation

46-89 ACO. Hit-Indicator Equipment for Gunnery Training with Frangible Bullets. **K. E. Burnham**, Bell Aircraft Corporation

46-90. Modern Double-Reduction Traction Motor. **Lanier Greer**, General Electric Company

46-91. High-Voltage Ignitron Rectifiers and Inverters for Railway Service. **J. L. Boyer, C. G. Hagensick**, Westinghouse Electric Corporation

**2:00 p.m. Lighting**

CP.* Lighting for Traffic Safety. **H. W. Osborne**, traffic advisor, Board of Safety, City of Buffalo

DP.** Bactericidal Effect of Ultraviolet Radiation. **H. C. Rentschler**, Westinghouse Electric Corporation

**3:00 p.m. Conference on Quality Control**

Panel Discussion: **Professor Martin Brumbaugh**, chairman, University of Buffalo; **Alfred J. Winterhalter, Jr.**, Colonial Radio Corporation; **J. Manuele**, Westinghouse Electric Corporation; **D. C. Stewart**, Buffalo Niagara Electric Corporation

**6:00 p.m. Dinner and Smoker**

### Friday, April 26

**9:30 a.m. Communication and War Developments**

CP.* Coaxial Buffalo–Cleveland Telephone Cable. (Tentative.) American Telephone and Telegraph Company

CP.* Radar Demonstration. **E. F. Herzog**, General Electric Company

DP.** The Radio Proximity Fuse. **L. G. Hector**. National Union Radio Corporation

DP.** Relays of the Sensitive Instrument Type in Target Seeking and Proximity Weapons. **A. H. Lamb**, Weston Electrical Instrument Company

DP.** The A B C of Servomechanisms. **S. W. Herwald**, Westinghouse Electric Corporation

**10:00 a.m. Student Conference and Technical Meeting**

Student Paper Presentations

DP.** Development Within the Profession **Everett S. Lee**, General Electric Company

**12:00 noon. Student Counselors' and Branch Chairman's Luncheon**

**Afternoon. Inspection Trips**

*CP: Conference paper; no advance copies are available; not intended for publication in *Transactions.*

**DP: District paper; no advance copies are available; not intended for publication in *Transactions.*

♯ACO: Advance copies only available; not intended for publication in *Transactions.*

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rolled Students and immediate families of members.

COMMITTEES

T. J. Brosnan, chairman, J. D. Hershey, secretary and treasurer, C. H. Anderson, M. Dewey, J. M. Geiger, R. G. Harper, R. T. Henry, W. S. Hill, R. J. W. Koopman, C. McIntosh, H. L. MacIntyre, J. H. Milbyer, L. J. Murphy, J. F. Oehler, W. K. Parks, G. M. Pollard, N. B. Phillips, J. L. Scanlon, J. E. Sowers, Jr., H. B. Vidal, H. E. Weiss, L. K. Yerger, G. A. Zehr.

## South West District Meets In San Antonio, April 16–18

All is in readiness for the South West District Meeting and Student Branch Convention to be held in San Antonio, Tex., April 16–18, 1946. Headquarters for the meeting will be in the Plaza Hotel. A program comprised of nine sessions, including two general sessions and a student session, has been arranged. Among the features of these sessions will be a discussion of Institute activities under the direction of the committee on planning and co-ordination and a special session on electrical problems in Mexico conducted entirely by members from the Mexico Section. On the social side a full program of dinners with entertainment, sport, and trips, as well as special events for the women, will assure a busy and enjoyable time for all who attend. The complete program and details were announced in the March issue of *Electrical Engineering*, pages 120–1.

# Southern District to Meet in Asheville, N. C., May 14–16

Asheville, high in the mountains of North Carolina, will be host to a three-day meeting of the Southern District and Student Branch convention, May 14–16, 1946. Headquarters will be in the Grove Park Inn.

In addition to the opening session a program of three technical sessions has been arranged and papers will be presented which are of special interest to electrical engineers in the South. Another session will be held at which papers will be presented by students and a conference on student activities also will take place. AIEE President W. E. Wickenden will address the meeting on the first evening and on the second evening a talk will be given by Commander J. F. Hellweg, United States Navy (retired), formerly of the United States Naval Observatory. Inspection trips have been arranged to visit a paper mill and a rayon plant, as well as the Glenville hydroelectric plant and the Cliffside steam plant.

On Monday evening preceding the opening of the meeting the following events have been arranged: Dinner at Grove Park Inn at 7:00 p.m.; Southern District executive committee meeting; Vice-President H. B. Wolf, presiding, at 8:00 p.m.; and an informal discussion of Institute affairs; Vice-President J. F. Fairman, presiding, at 8:30 p.m.

### ADVANCE REGISTRATION

Members of the District, who will receive an advance registration card, should register in advance by filling in and mailing the card. A two dollar nonmember registration fee will be charged all nonmembers except Enrolled Students and the immediate families of members.

### HOTEL ACCOMMODATIONS

Members should make their own hotel reservations by writing directly to the hotel preferred. It is advisable to make reservations as early as possible.

### COMMITTEES

**General:**
J. F. Rader, H. W. Oetinger, *cochairmen;* C. P. Almon, Jr., P. J. Carlin, J. A. Crisman, Carl W. Evans, S. H. Gates, William Stone Leake, W. E. Lindemann, Otto Meier, Jr., J. A. Rawls, F. T. Tingley, F. C. Weiss

**Hotel and Registration:**
H. H. Gnuse, Jr., *chairman;* W. F. Sanders, C. O. Warren

**Transportation and Inspection Trips:**
M. F. Leftwich, *chairman;* H. C. Crossley, H. E. Wilson

**Attendance and Publicity:**
Harold Lampe, *chairman;* F. C. Alexander, W. W. Ballew

**Technical Papers:**
F. W. Chapman, *chairman;* W. J. Seeley

**Finance:**
H. B. Robinson, *chairman;* W. H. Kendrick

**Sports and Entertainment:**
G. O. Bason, *chairman;* Dean H. Davis

**Ladies' Entertainment:**
Mrs. Howard Strock, *chairman;* five to be appointed

**Student Activities:**
Otto Meier, Jr., *District chairman;* E. O'Brien, *national chairman*

## Tentative Technical Program and Meeting Features

**● PAMPHLET reproductions of authors' manuscripts of the numbered papers listed in the program may be obtained as noted in the following paragraphs.**

**● ABSTRACTS of papers are expected to be available for the May issue.**

**● PRICES and instructions for procuring advance copies of these papers will accompany the abstracts. Mail orders are advisable, particularly from out-of-town members, as an adequate supply of each paper at the meeting cannot be assured. Only numbered papers will be available in pamphlet form.**

### Tuesday, May 14

**8:30 a.m. Registration**
**10:30 a.m. Opening session**

Address of welcome by the Mayor of Asheville

Remarks by Vice-President **H. B. Wolf**

Remarks by President-elect **J. E. Housley**

Talk on Institute Planning by Vice-President **J. F. Fairman**, chairman, committee on planning and co-ordination

**2:30 p.m. Meeting of Board of Directors**

**2:30 p.m. Symposium on Electric Power in the Textile Industry**

DP.* Viewpoint of Manufacturer, **W. L. Bross**

DP.* Electric Power in the Textile Industry—Viewpoint of Design Engineer. **George Wrigley**, J. E. Sirrine and Company

DP.* Application of Electric Power to Textile Plants As Viewed by the Electric Utility. **C. G. Mattison, W. K. Harding,** Duke Power Company

DP.* Electronic Heating in Textile Manufacture. **H. T. Smith,** The Girdler Corporation

DP.* Price Is a Function of Wages. **F. U. Ross,** Virginia Electric and Power Company

DP.* The Responsibility of AIEE to the High School. **W. E. Lindemann,** Tennessee Valley Authority

**8:30 p.m. Address by President W. E. Wickenden**

### Wednesday, May 15

**8:30 a.m. Business Meeting, North Carolina Section**

**9:00 a.m. Student Papers Session**

**9:00 a.m. Technical Session**

46-96. Maintenance of Rectifiers on Electrochemical Installations. **J. E. Housley, G. M. Hughes,** Aluminum Company of America

DP.* Industrial Power Distribution. **R. H. Kaufmann,** General Electric Company

46-97. Lightning Protection for Industrial Plants. **E. W. Beck, J. Z. Linsenmeyer,** Westinghouse Electric Corporation

DP.* Factors Affecting Range of Radar Sets. **L. R. Quarles, W. M. Breazeale,** University of Virginia

**2:00 p.m. Inspection Trips**

Ecusta Paper Corporation
Glenville Hydroelectric Plant
Cliffside Steam Plant

**8:30 p.m. Evening Session**

Presentation of student prizes by **E. W. O'Brien,** chairman, committee on Student Branches
Talk by Commodore **J. F. Hellweg,** United States Navy (retired), formerly of United States Naval Observatory

### Thursday, May 16

**8:30 a.m. Conference on Student Activities**
**9:00 a.m. Technical Session**

DP.* 115-Kv Cable Installation in Atlanta. **R. O. Loomis,** Georgia Power Company

46-98. Selective Ground Relaying of an Ungrounded System. **E. P. Miller,** South Carolina Electric and Gas Company

DP.* Centralized Control of a Power System. **Perry Peterson**

DP.* T.V.A. Communications Facilities. **T. deWitt Talmage,** Tennessee Valley Authority

First-prize student paper

**2:00 p.m. Inspection Trips**

Enka Rayon Corporation
Glenville Hydroelectric Plant
Cliffside Steam Plant

*DP.: District paper; no advance copies are available; not intended for publication in *Transactions.*

## Philadelphia Gains 1,000th Member

Announcement that the membership of the Philadelphia AIEE Section has reached 1,000 recently was made by M. L. Lehman (M '36) chairman of the Section's membership committee.

The 1,000th member is Winfield A. Scott (A '38) now of the Bell Telephone Company of Pennsylvania. Until this time Mr. Scott, who had been serving a a lieutenant in the United States Army, had been on the AIEE military inactive list, and he has just resumed his active membership status.

**Grove Park Inn, headquarters for the Southern District meeting, Asheville, N. C., May 14–16**

## AIEE Board of Directors Meeting

The regular meeting of the board of directors of the American Institute of Electrical Engineers was held at Institute headquarters, New York, on Thursday, January 24, 1946.

Upon recommendation of the committee on planning and co-ordination and the special committee on registration of engineers, the board adopted a resolution that the AIEE recognizes the registration of engineers as a continuing practice and endorses the Model Law for Professional Engineers and Land Surveyors, as adopted in 1943 and amended in 1945 by a joint committee of several engineering societies, as the widely accepted basis of its administration, and that the Institute endorses these procedures as well established. Also, upon recommendation of these two committees, the board authorized the establishment of a standing committee on registration of engineers, to replace the special committee. The possibility of assigning other functions to the committee was suggested, and the committee on planning and co-ordination was requested to report recommendations concerning the scope of the committee. The special committee on registration of engineers was continued until the appointment of the standing committee.

The establishment of joint Student Branches of AIEE and the Institute of Radio Engineers wherever desired was authorized, as recommended by the committee on Student Branches, and to that committee was delegated the responsibility of carrying out the policy.

Executive committee actions at an evening session on January 21, 1946, were approved as follows:

Approval of recommendations adopted by the board of examiners at its meeting on December 13, 1945.

Appointments as follows:

J. W. Barker and I. Melville Stein as AIEE representatives on the Council of the American Association for the Advancement of Science for the calendar year 1946.

N. Thornton as Local Honorary Secretary of the Institute for Northern India for the unexpired term, ending July 31, 1946, of V. F. Critchley, resigned.

J. M. Standring, Jr., as one of the representatives of AIEE on the American Co-ordinating Committee on Corrosion for the remainder of the current administrative year, to succeed E. B. King, resigned.

Appropriation expenditures, reported by the chairman of the finance committee, were approved, as $25,920.24 in December and $32,449.42 in January.

It was decided to hold the 1946 annual meeting of the Institute in Detroit, Mich., on Wednesday, June 26.

Upon recommendation of the committee on planning and co-ordination, the winter convention, New York, N. Y., January 27–31, 1947 and the Middle Eastern District meeting, Dayton, Ohio, fall of 1947, were authorized.

Vice-President M. S. Coover was appointed to attend the presentation of the Washington Award to Doctor Vannevar Bush, February 20.

An invitation to be represented at the inauguration of Arthur Holly Compton as Chancellor of Washington University, on February 22, was referred to the President with the understanding that if unable to attend himself he would appoint the chairman of the St. Louis Section.

A bequest of $10,000 from the late W. S. Barstow was accepted, and the execution of the necessary legal steps for its payment was authorized.

It was decided to hold the May meeting of the board of directors in Asheville, N. C., on the afternoon of Tuesday, May 14, during the Southern District Meeting.

The following amendments to the bylaws, recommended by the committee on constitution and bylaws, were adopted:

Section 48. Amended to read as follows, to conform with the new method of allotting funds to the Sections adopted by the board November 2, 1944: Each Section shall conduct its affairs in such a manner as to require for its maintenance only such financial support by the Institute as is consistent with the activities carried on by that Section. Except upon the request of a Section stating specific reasons therefor, and with the approval of the Sections and finance committees, the appropriation of Institute funds during any year shall not exceed in the aggregate a sum to be determined as follows:

(*a*). Two-hundred dollars basic allotment

(*b*). One dollar and twenty cents for each Institute member within the Section territory on August first

(*c*). An additional amount for a larger number of regularly scheduled Section, Subsection, and technical group meetings held during the preceding fiscal year (ending April 30) as follows:

1. Twelve to 17 meetings, 25 dollars
2. Eighteen to 23 meetings, 50 dollars
3. Twenty-four or more meetings, 75 dollars.

The Treasurer and Secretary of the Institute shall forward in October of each year to the Secretary of each Section one-half of the sum to which the Section is entitled under this bylaw, less any unexpended balance in the funds provided by the Institute during the preceding year and which shall be considered as part of the payment for the current year. An accounting shall be made to the finance committee of the Institute, through the Secretary, when these funds have been expended, whereupon the

# Part of the Detroit Setting for the Summer Convention

The above view of the Ford Rouge Plant is indicative of the industrial background of the forthcoming summer convention to be held in Detroit, Mich., June 24–28, 1946, with headquarters at the Statler Hotel.

Sessions are being planned covering electric welding, electronic devices and basic circuits, electronic applications, industrial control devices, management and quality control, power transmission and distribution, and cables. A symposium on grounding is planned, sponsored by the committee on safety. It is expected also that technical conferences will offer opportunities for the discussion of such subjects as servomechanisms, supervisory control of air switches, automatic switching of capacitor banks, and teaching aids for electronic instruction.

Inspection trips being planned include: The Ford River Rouge Plant, where a typical cross section of modern automotive production may be seen, including all phases from foundry and steel mill to assembly and finishing lines; U. S. Rubber Company plant, where the intricate and fascinating sequence of operation involved in the modern manufacture of automobile tires may be viewed; General Motors Proving Ground, to observe a typical example of the exacting tests which the automotive industry prescribes for its products; Edison Institute Museum at Greenfield Village, founded and endowed by Henry Ford, which represents an extensive cross section of human and technical history. Many entertainment features are planned.

Under the direction of S. M. Dean, chairman, T. G. Glenn, vice-chairman, and W. F. Wetmore, secretary–treasurer, the following committee chairmen, with their respective committees, are functioning to assure that the Detroit convention will be long remembered: M. A. Bergdahl, Hospitality; D. D. Chase, Sports; H. W. Collins, Hotels; A. J. Koetsier, Publicity; A. E. Kreigsmann, Meetings and Papers; W. J. Piper, Information and Transportation; V. J. Snyder, Finance; R. C. Spaulding, Inspection Trips; F. R. Temple, Registration; and Mrs. M. A. Bergdahl, Ladies' Hospitality.

The full program is scheduled to be published in the May issue of *Electrical Engineering*.

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balance of the appropriation for the year shall be sent to the Secretary of the Section for which an accounting will be made at the end of the year.

Section 65. Amended by the addition to the list of technical committees of the name of the committee on industrial control devices, established by authority of the board of directors on May 29, 1945.

Map portraying the Geographical Districts of the AIEE, in conformity with action of the Board of Directors on May 29, 1945, transferring the Mexico Section from District 3 to District 7, changed as follows:

In the statement of the New York City (District 3) territory, the parenthetical expression "(Canada excepted)" changed to "(Canada and Mexico excepted)."

The heavy boundary line between Texas and Mexico moved to indicate that Mexico is a part of District 7.

Throughout the bylaws, the word "national" deleted wherever it occurs in the titles of officers, committees, and meetings, to conform with the constitution as amended in 1945.

In view of the fact that the income from the Edison Medal Fund has been insufficient in recent years to cover the increased cost of the Edison Medal due to the high cost of gold, plus taxes, the board voted to establish the policy of paying from the Institute treasury the amount of the cost of the Edison Medal in any year which is in excess of the income from the Edison Medal Fund, thus making possible, though not mandatory, an annual award of the medal.

The board authorized the usual travel expense allowance for delegates from District 8 and the University of British Columbia Branch to a joint conference on Student activities to be held in District 9 during the 1946 Pacific Coast convention, in Seattle, Wash., August 27–30.

Other actions taken included:

Minutes were approved of the meeting of the board of directors on October 18, 1945, and of the meeting of the executive committee on December 11, 1945.

Recommendations adopted by the board of examiners at a meeting on January 17, 1946, were approved. The following actions were taken upon recommendation of the board of examiners: 6 applicants were transferred to the grade of Fellow; 25 applicants were transferred and 57 were elected to the grade of Member; 206 applicants were elected to the grade of Associate; 364 Student members were enrolled.

Those present included:

*President*—W. E. Wickenden, Cleveland, Ohio. *Past-president*—N. E. Funk, Philadelphia, Pa. *Vice-presidents*—C. B. Carpenter, Portland, Oreg.; M. S. Coover, Ames, Iowa; F. F. Evenson, San Diego, Calif.; J. F. Fairman, New York, N. Y.; E. S. Fields, Cincinnati, Ohio; R. T. Henry, Buffalo, N. Y.; F. L. Lawton, Montreal, Quebec, Canada; L. M. Robertson, Denver, Colo.; R. W. Warner, Austin, Tex.; Herman B. Wolf, Charlotte, N. C. *Directors*—P. L. Alger, Schenectady, N. Y.; J. M. Flanigen, Atlanta, Ga.; C. M. Laffoon, East Pittsburgh, Pa.; M. J. McHenry, Toronto, Ontario, Canada; C. W. Mier, Dallas, Tex.; S. H. Mortensen, Milwaukee, Wis.; W. B. Morton, Allentown, Pa.; J. R. North, Jackson, Mich.; D. A. Quarles, New York, N. Y.; W. C. Smith, San Francisco, Calif.; W. R. Smith, Newark, N. J. *Treasurer*—W. I. Slichter, New York, N. Y. *Secretary*—H. H. Henline, New York, N. Y.

# Planning Subcommittee Issues Progress Report On Study of Organization of Engineering Profession

Full text of a progress report prepared by the AIEE planning and co-ordination committee's professional activities subcommittee; T. G. LeClair (F '40) chairman, M. S. Coover (F '42), W. S. Hill (M '30), B. D. Hull (F '39), and F. E. Sanford (M '34)

**Editor's Note: Presented for purposes of discussion, the accompanying progress report of the professional activities subcommittee represents the subcommittee's initial effort and interpretation of its assignment. As variously reported in ELECTRICAL ENGINEERING during recent months, the AIEE committee on planning and co-ordination was assigned the task of studying AIEE activities with a view toward determining possible ways and means of extending or improving them in the interest of better service to the membership. The planning and co-ordination committee divided this job, and established a technical activities subcommittee to cover the field indicated by its title, and a professional activities subcommittee to cover all other activities and intersociety relationships.**

**The substance of this progress report was presented and discussed informally at an afternoon session during the recent winter convention. The present expressed intention of the subcommittee is to stimulate active membership discussions of these proposals in all Sections during the immediately forthcoming months, thus laying the foundation for a further general discussion which is contemplated for the summer convention conference of officers, delegates, and members.**

**It seems desirable to emphasize that the purpose of this presentation is not to promote the quick choice of any one "plan" as against any other "plan," but rather to stimulate thought and discussion through which to determine and to clarify membership understanding and desires as to basic AIEE objectives.**

Evolutionary developments in engineering, membership in the Institute, and the activities of the Institute all have expanded so rapidly in recent years that the committee on planning and co-ordination was given the assignment of analyzing all the Institute's activities in order to determine in what way it could be of greater service to the members. The committee on planning and co-ordination appointed two subcommittees to study two phases of the problem. The technical activities subcommittee was assigned the task of studying the Institute's technical activities, such as technical papers, Standards, transactions, technical committees, and other related activities as well as the corresponding activities in other societies. The professional activities subcommittee was assigned the task of studying the Institute's place in relation to such subjects as compensation, professional ethics, engineering registration, and all other activities having to do with the professional activities of engineers and their contacts with the public in general.

It was immediately apparent that nearly all professional activities are common to all branches of the engineering profession and, therefore, affect all the existing engineering societies and their relations with each other. Consequently it was found necessary to analyze the broader problem of organizing to handle professional activities for all engineering societies, not merely the AIEE.

Many suggestions have been considered by the subcommittee for means of improving the efficiency of engineering society activities along professional lines. Most of the problems are so interrelated that the subcommittee decided to consider the entire field and approach first the ideal method of organizing the engineering profession with the thought that later consideration would be given to practical compromises if agreement could be reached on a common goal. A small subcommittee having limited contacts and not knowing the desires of 25,000 members did not feel competent to recommend directly a general approach to the organization question without learning the wishes of a larger body of members. Therefore, the subcommittee has prepared brief discussions on four methods for organizing the engineering profession, and submits them for general discussion and comments from the members. None of the four plans described is intended as a finished product. The description is solely for the purpose of stimulating comment and obtaining a cross section of members' opinion before the subcommittee undertakes further detailed work.

The recommendation of the subcommittee is that these plans be published in *Electrical Engineering* and that a questionnaire be made available to all Institute members having a special interest in this problem, and particularly to members of the executive committees of all Sections. The answers to the questionnaire will be used to determine the future course of action of the subcommittee.

This preliminary report may appear to parallel, if not to conflict, with activities which are being undertaken by other groups. The broadest activity under way at the present time is under the sponsorship of the Engineers Joint Council, an organization with representatives from the following engineering societies: AIEE, American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Civil Engineers, American Institute of Chemical Engineers. This council has appointed 15 men to committees which have been active for some months but have issued no reports. It is hoped that information obtained through the activity of the AIEE subcommittee will be a valuable guide to the Institute itself, and also will serve as a reference to the committees representing the several other engineering societies.

The four plans presented herewith are not intended to be the only possible plans available. They have been selected primarily because they represent a variety of approaches to the problem. It is suggested that members keep an open mind and consider all plans before concluding whether one of them or some other appears to be the most practical for creating a strong united engineering profession.

Of the four plans, one, plan *A*, covers only the electrical engineering field. A plan once operating effectively in this field might be expanded to cover all fields of engineering. The other three plans, *B*, *C*, and *D* cover the entire engineering field and have as their objective creation of a strong united engineering profession.

A brief description of each of the plans follows.

Plan *A* proposes consolidating the existing electrical engineering societies only into a new *American Association of Electrical Engineers* which would unite those practicing in all fields of electrical engineering to be more effective than is possible with the several societies now in existence.

Under this plan, the initial unifying efforts are confined to the field of electrical engineering. Its proponents hope that the experience gained in creating a functioning American Association of Electrical Engineers will indicate how the plan could be expanded to accomplish the broader objective of creating an all-inclusive engineering society and that this process of development might result in an all-inclusive engineering society that would function successfully for all those practicing engineering regardless of the field.

Plan *B* proposes that the existing engineering societies continue to function in technical matters and that a separate autonomous *Engineering Profession Society* of which all engineers would be members should carry on nontechnical or general activities of interest to engineers.

Plan *C* proposes a federation of council of all existing engineering societies so that *The Federated Engineering Societies* would provide a single channel for consideration

and action on all technical and professional matters of interest to engineers.

Plan *D* proposes the setting up of a new *American Society of Engineers* into which would be incorporated many of the existing societies. This society would have all engineers as members and would function in all technical and professional activities involving engineers.

These plans were presented and discussed at the winter convention in New York, N. Y., January 1946.

### HISTORICAL INTRODUCTION

In considering the need for action to unify the engineering profession, it might be well to review how engineering developed and how there was a corresponding development of engineering societies. Rather than cover the entire field of engineering, the electrical engineering field will be reviewed as being, in general, representative of similar developments in other branches of engineering.

The electrical industry, which was founded by Thomas Alva Edison in 1882 when he gave to the City of New York and to the world the first electric lighting system, still is expanding over ever-widening areas and apparently with limitless boundaries. The growth of the electrical industry has been rapid and phenomenal. It has been developed to the point where it touches in one way or another the lives of all peoples and nations.

Just as Edison gave to the world the electric power industry, so did Morse, Bell, Marconi, and others give electrical communication systems in order that intelligence might be transmitted by faster means than the pony express or wheel-borne vehicles.

Technical advances that were made in the electrical field during the period of World War II have been enormous. It is doubtful if the same progress would have been made under normal conditions in a quarter of a century. The fact remains that today there are many specialized areas within the electrical engineering field. There are so many individuals engaged in those areas that already there is evidence of further expansion of technical societies or organizations so that engineers may meet on common technical grounds for their personal and professional development.

As a result of the work of Edison and others, there soon came the desire for an association of electrical engineers, and in 1884 the American Institute of Electrical Engineers was founded. It fulfilled the immediate needs of the electrical engineers in the power and the communication fields. The Institute grew and it prospered because it rendered a useful service.

It was not long before further specialization began to develop the desire of men thus engaged to come into closer touch with one another for more effective public service; for the reading and discussion of appropriate papers; and for the advancement of engineering and scientific knowledge in their respective professional areas. So it was that the Electrochemical Society was founded in 1902.

With the rapid adoption of electric lighting, the development and manufacture of new and improved lighting units, and the establishment of lighting standards, a demand developed among those working in these fields to band together. The Illuminating Engineering Society consequently was formed in 1906.

Concurrently with the commercialization of radio came an ever-growing need for engineers in that vocation to work in closer harmony. This industry was creating a demand for and absorbing more and more electrical engineers with each passing year. It was only natural for those engineers to want to organize among themselves. The pressure for organization was great, the need was apparent, and the Institute of Radio Engineers became a reality in 1912.

### CURRENT DEVELOPMENTS

The tremendous development and application of electronic devices within recent years has created new specialized groups and the possibility of new corresponding societies being formed. It is well known that the first National Electronics Conference held in Chicago in 1944 was planned for an expected attendance of around 500 and that approximately 2,200 were in attendance. The results in terms of interest were overwhelming and the potentialities of another group of electrical engineers banding together are great. Those interviewed on the subject agreed almost without exception that the formation of an organization covering the field of electronics is likely.

Aviation electrical engineers are growing in numbers, and increasing numbers of electrical engineers are being engaged in other highly specialized fields of electrical engineering. To what end may all this lead? Will an expanding number of corresponding societies provide greater professional benefits than a well-co-ordinated single over-all organization? The technical gains achieved through specialized societies may be outweighed by the accompanying social and economic handicaps. The engineer needs, and rightfully deserves, to reap all possible advantages.

### SIMILARITY OF ENGINEERING ORGANIZATIONS

There is a marked similarity among many of the existing engineering organizations in the various fields of engineering, as well as among those in a single specialized field.

Many engineers hold membership, and quite a few hold office and committee assignments, in two or more of the present national engineering organizations. These similarities may indicate a way to unite all engineers in some single organization.

Many of the societies have general committees which carry on similar activities and even may have the same name. The following are some of these committees: executive, finance, constitution and bylaws, publication, advisory policy, membership, board of examiners, Sections, nominations, education, and awards.

Since each society functions in its own technical field, there is less similarity among their technical committees except for research, Standards, and like committees. The technical interests are, however, so interrelated that all engineers should consider themselves members of one engineering profession.

### FUNCTIONS OF ENGINEERING ORGANIZATIONS

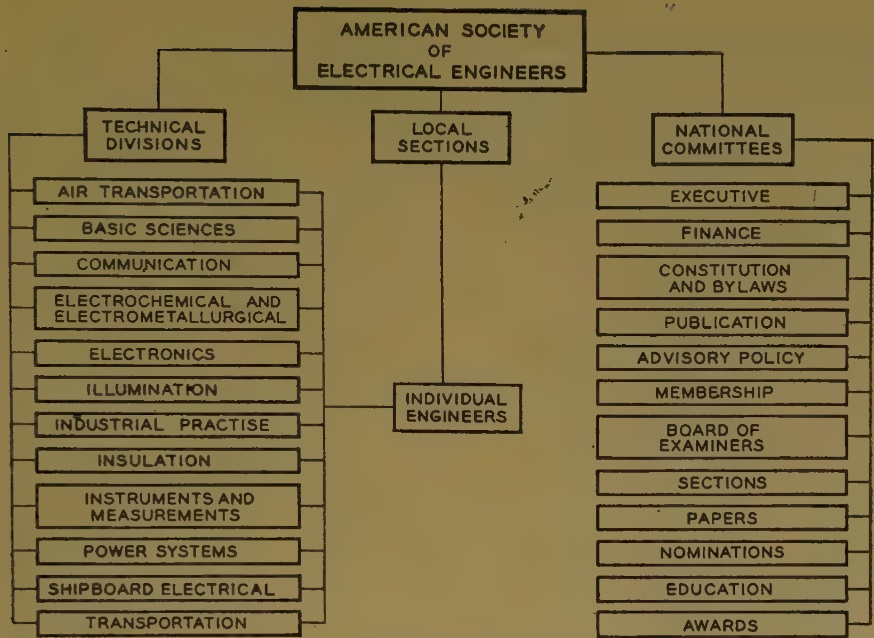
Engineering societies seem to have been organized for the purpose of carrying on one or more of the following functions:

(*a*). *Technical advancement or "the advancement of the theory and practice of (a particular branch of) engineering."* During more than 300 years, men interested in science have been meeting to exchange views on their observations and experiences and to discuss their problems. These "town meetings" of technological progress continue to provide engineers and scientists of our generation contact with the current work of others. They make possible a continuation of the individual's education in his chosen field and encourage interest in new developments. The traditional purpose of engineering organization is to provide a convenient path for the expeditious flow of technical information among the members and to broaden their interests in fields other than their own.

(*b*). *Engineering education.* Studies of engineering training and the development of plans for student selection and guidance are matters for joint consideration by engineers in every line of endeavor as well as by engineers in academic life. The professors may conduct the formal educational process but practicing engineers should interest themselves in the content and standards of formal engineering education, in the selection and guidance of suitable candidates for an engineering education, and in the postgraduate training and professional development of the young engineers.

(*c*). *Advancement of the profession.* It is not axiomatic that a unified association of practitioners automatically will place a profession on a pedestal of dignity and prestige. Nor does it follow that licensing or registration by the state in themselves will assure appropriate public recognition of a profession. But it does seem that these may be among the factors which would further the advancement of the profession. Other factors might be a uniform code of ethics and canons of practice, a common recognition by the profession of what constitutes full professional status, assistance to engineering graduates in attaining that status, greater responsibility for legislation affecting the standards and the practice of the profession, assistance to members of the profession in obtaining employment, establishment of schedules of fees and salaries for professional services commensurate with the value of such services, and active support of the individual members in maintaining the integrity, dignity, and independence of the profession.

(*d*). *Public service.* Events of recent years have served to emphasize the important part which engineers as individuals and as organized groups can and should play in public affairs. It would seem reasonable to expect that engineers should




**Plan A organization**

be able to apply their talents for the effective and efficient organization of men and materials to the problem of rendering a disinterested public service as a professional group at the several levels of government. Such service should be rendered in times of peace as well as during national emergencies. Definite avenues for co-operation with government agencies should be established and used.

### THE PROBLEM

How should the engineering profession be organized to carry out the foregoing functions to best advantage? The four plans discussed are intended to attain the same broad objectives. The differences are only in method. Which will work best? Which can be put into operation most expeditiously? What combination of these or what other plan would serve the purpose better? What are the advantages and disadvantages of each? The committee is seeking answers to these and related questions.

### PLAN A. AMERICAN ASSOCIATION OF ELECTRICAL ENGINEERS

This plan proposes the consolidation of existing electrical engineering societies only into a new single unified society which for the purposes of this discussion will be called an American Association of Electrical Engineers. All engineers practicing in any field of electrical engineering then would be eligible to become members of the same society. Deliberations and actions taken would be on the basis of what would be most beneficial for all electrical engineers.

The experience gained in establishing a functioning American Association of Electrical Engineers might indicate how an all-inclusive Engineering Society could be created that would serve all engineers and bring about a strong united engineering profession.

*Organization Required.* An American Society of Electrical Engineers should be organized to get maximum individual member participation. This would require division of the Society into as many technical groups as would be necessary to cover the main technical fields which now exist or which might exist in the future.

*Attaining Organization.* Organizing an American Society of Electrical Engineers presumably would require dissolving the existing national electrical engineering organizations after merging all their activity in the new American Society of Electrical Engineers.

This merging would be accomplished by having a joint committee composed of representatives of the American Institute of Electrical Engineers, Institute of Radio Engineers, Illuminating Engineering Society, Electrochemical Society, and of groups which seriously may be considering organizing, such as those in the electronic field.

The general committee would be supplemented by having similar common committees, such as executive, financial, membership, publication and others, sit in joint conference and conscientiously try to develop a unity that would enable the American Society of Electrical Engineers to function properly.

These committees would determine the grades of membership, technical publications, and other matters on which there would have to be agreement in forming the new American Society of Electrical Engineers.

In this "Constitutional Convention" certain sovereign rights of the component groups would be surrendered to the new American Society of Electrical Engineers. Then with the dissolution of the component groups, the new American Society of Electrical Engineers would carry on and function for all electrical engineers.

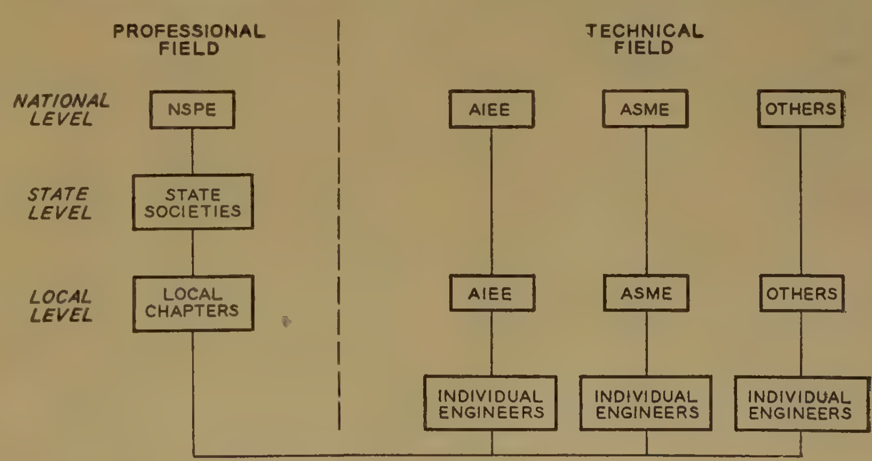
*Technical Publications.* A publication containing articles of general interest would be given to each member. In addition, each of the technical divisions could have its own separate publication. Any member could subscribe for as many of these as he wished to receive by paying additional fees, which would be based on cost and vary with the amount of approved material each technical division published.

*Membership.* Grades of membership in the American Society of Electrical Engineers would have to be established which would be available to individuals at a fee to be determined.

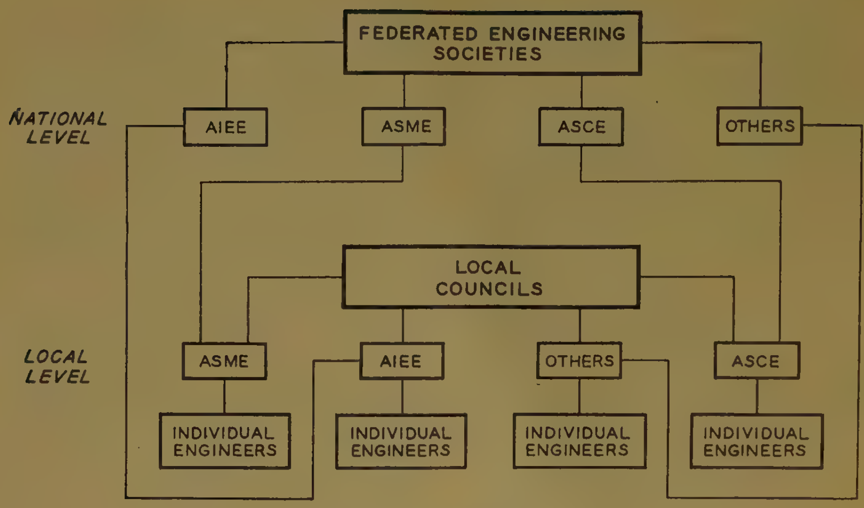
### PLAN B. ENGINEERING PROFESSION SOCIETY PARALLELING PRESENT ENGINEERING ORGANIZATIONS

This plan is based on the existing engineering organizations continuing to function in all technical matters and having an Engineering Profession Society carry on those nontechnical or general activities which are of interest to the engineering profession. Broadly, these activities are advancement of the profession as a whole and providing more effective public service.

*Organization Required.* This Engineering Profession Society should be organized so as to get maximum individual member participation in all matters falling within the scope of its activities. To facilitate such




**Plan B organization**




**Plan C organization**

participation, the basic unit should be the local chapter confined to the smallest practicable geographic or political area. The basic unit, therefore, could be the county. For greater effectiveness in dealing with civic and professional problems extending beyond the community, these chapters should be combined to form a state society. The state societies should in turn be united to form a national organization. The ideals and opinions of the individual engineers would be the basis of pronouncements by the society which then might be recognized by the public as the voice of the engineering profession.

*Attaining Organization.* Such an Engineering Profession Society if newly organized, would have a long hard struggle to acquire a membership sufficiently large to claim to be speaking for the entire engineering profession. It therefore would seem more expeditious to select and support some one existing society which was organized to accomplish the purposes of an Engineering Profession Society and which exhibits characteristics of steadily growing strength and influence. It is to be noted that this plan requires action by individual engineers rather than by organizations of engineers.

*Membership.* The membership of the Engineering Profession Society would be comprised entirely of individual engineers and there would need to be only one grade of membership. As 46 states have engineering registration laws, a requirement for membership well might be legal recognition by the state as being qualified to practice the profession of engineering.

### PLAN C. FEDERATED ENGINEERING SOCIETIES

This plan proposes federation of existing engineering societies to form the Federated Engineering Societies. Federation would provide a single control for consideration and action on all technical and professional matters of interest to engineers.

*Organization Required.* The existing societies would have to find some basis for acting in a federation so that the constructive efforts of all could be applied to any problem considered.

The pattern for unifying existing engineering organizations is being developed in numerous local council and affiliation plans. Their stable and continued growth may indicate that the Federated Engineering Societies could meet the needs of engineers.

*Attaining Organization.* Federation of the existing engineering societies should create a strong Federated Engineering Society because their combined membership includes the majority of engineers and also because their combined activities include practically every activity that might add to the development of the engineering profession in its broadest scope.

In order to attain federation without delay and as smoothly as possible, the major national technical societies should take the lead with a positive approach toward unification and take the action required to supplement the small steps made already in the right direction.

For each society, the creation of an over-all organization for matters that are of common concern to all engineers is merely a pooling of efforts to improve the results. Engineers' Council for Professional Development seems to show that this idea has possibilities.

The steps that each society could take to facilitate federation are:

1. Expand this idea of joint action, on both a national and a local basis, by appointment of joint committees to work out specific solutions for the several specific problems of common interest to two or more of the present national organizations, such as licensing and professional recognition, or the matter of competition or overlap in technical programs.

2. Publish a general interest magazine to go to all individual members of all co-operating societies, both national and local. This magazine would publish top-notch articles now often limited in circulation to one society, plans and suggestions for local activities, an interchange of practical ideas, and reviews of technical advances based on papers in the technical societies.

3. Carry into engineering organizations the type of investigation which led to the Wickenden report for engineering education. The same improvements and the softened department border lines that have followed in college viewpoints are being sought in this new field, and there is a large amount o spade work involved in continuing this program.

4. Aim at an ultimate organization of the American Medical Association type, with its technical sections and local affiliations modified for our particular needs, realizing that this goal was not for them, and would not be for us, a single stroke achievement.

### PLAN D. AMERICAN SOCIETY OF ENGINEERS; A SINGLE SOCIETY WITH INDIVIDUAL MEMBERSHIP FOR ALL AMERICAN ENGINEERS

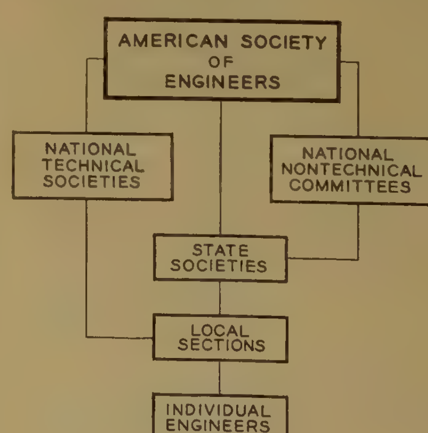
This plan proposes the setting up of a new American Society of Engineers into which would be incorporated many of the existing engineering societies.

*Organization Required.* Local sections and state societies would be the basic units in such a national organization. An individual who joined a local and state society would be eligible for individual membership in the American Society of Engineers and for membership in the national technical societies which would become subsidiaries of the American Society of Engineers. All activities other than technical would be carried on by state and national committees of the general society, each functioning in a special field of interest. All technical activities would be carried on by the national technical societies which would retain their present principle function, but drop all those activities related to the professional field.

The national technical societies would co-ordinate any sectional activities related to their technical field while the national professional committees would serve as the co-ordinating agency on problems of a professional nature and would serve as the spokesman for all engineers on national matters.

*Local Sections.* To meet individual needs, the basic organization would be built on local sections such as the Chicago Engineering Society or the New York Engineering Society. In more sparsely settled territories the local section might cover several counties instead of a single city.

The local sections would provide a general service to co-ordinate meeting dates, provide meeting quarters, and sponsor general meetings on the broader phases of engineering. The local sections also might have committees subsidiary to state com-




**Plan D organization**

mittees on legislation, civic activities, education, and other matters. These would co-operate with other local groups.

The handling of local section meetings on specialized technical subjects would be exactly the same as at present, except that branches of the local section would be formed to fill the needs of each locality. Thus a local section might have groups on steam generation, machine tools, chemical processes, industrial power, communication, aeronautics, dam construction, rivers and harbors, and electric power generation instead of having these subjects under the national societies as is the present practice. These groups would be co-ordinated, however, with the national technical societies. The responsibilities of the individuals would not be changed materially.

*State Society or Regional Organization.* A state society to be known as the Pennsylvania Society of Engineers, for example, would represent all those in the area on statewide general interest problems. In some instances, a regional organization might substitute for more than one state society. The state society would maintain mailing lists, process all applications for membership, maintain contact with student branches and the other professions within the state, and deal with all state legislation affecting the profession.

*Student Branches.* Student branches of the American Society of Engineers would be formed in all engineering colleges instead of branches of each specialized society. Co-ordination with the specialized technical societies would be accomplished through committee contacts. Separate student committees representing the specialized fields would conduct technical meetings. The number of students and the variety of the curriculum would determine what meetings would be held and the size of the organization for conducting them.

*National Society.* The American Society of Engineers through its top board of direction would act only on subjects of general national importance through committees shown in the organization diagram. Each state or regional society might be represented through a single representative on a board of trustees. The present national technical societies, practically intact, would be made a part of the American Society of Engineers. They would drop direct action on general subjects affecting all branches but each would continue to conduct its own conventions and standardizing activities and be co-ordinated with the technical groups under the local societies, furnishing papers, sponsoring prize awards for papers, and arranging for delegates to attend the various national conventions.

*Membership Qualifications.* To co-ordinate the various grades of membership of the present specialized technical societies, it is proposed that the basic voting grade of membership be available not only to registered professional engineers, but also to others having equivalent qualifications. The states registration requirements, while varying somewhat, are on nearly the same level and are being made more uniform.

A lower grade of voting membership would be equivalent to "engineer in training." This now has become a legally recognized status in some states, and is being adopted rapidly in others.

Nonvoting grades of membership, for which the qualification requirements would be lower, would include student members, affiliates, and local members. These would not be eligible to hold office in any of the state or national society activities.

Only a small number of persons might be eligible for a higher qualification such as honorary member or fellow. This grading would be administered on a state level for purposes of co-ordination.

# Fifth Progress Report on AIEE Aeronautical Standards

Standardization work concerning aeronautical electric equipment still is being carried on under the direction of the AIEE air transportation committee. This report, which follows the fourth progress report (*EE, Jan '46, p 36*), brings up to date the status of the various projects.

### AIRCRAFT ELECTRICAL SYSTEMS SUBCOMMITTEE

Under the chairmanship of R. H. Kaufmann (M '41) preliminary data concerning about half of the sections in the proposed report on aircraft electrical systems have been accumulated, and it is planned to compile these data in draft form for circulation and review at an early date rather than wait for information covering all of the sections to be accumulated. Some of the contributions to this report have been held up due to shifting of personnel in industry. This project is considered very worth-while by other interested bodies as well as by the air transportation committee and every effort is being made to obtain the necessary data for completion. Full co-operation is being give by Aeronautical Radio, Inc., a company which has done considerable work of this type. The AIEE report will be an informative type of report giving pertinent application and performance data, description of aircraft electrical systems, and so forth. Anyone having any data along these lines is urged to get in touch with R. H. Kaufmann, General Electric Company, Schenectady, N. Y.

### AIRCRAFT ELECTRIC ROTATING MACHINERY SUBCOMMITTEE

A test code for d-c aircraft motors is in process of preparation and the third meeting of the subcommittee was held on January 22, 1946. Editorial work now is being undertaken to correlate the various sections of the proposed test code so that it will form a comprehensive composite unit. It is expected that the proposed test code will be ready for submission at the June meeting. M. L. Schmidt (M '43) is chairman.

### AIRCRAFT ELECTRICAL CONTROL AND PROTECTIVE DEVICES SUBCOMMITTEE

The membership of this subcommittee (R. A. Millermaster (M '34) chairman) has been particularly upset due to industrial reconversion. Its work is being co-ordinated with that of the electrical systems subcommittee and also with the cable subcommittee. The work on control and protective devices will be crystallized when the other groups have advanced further.

### AIRCRAFT WIRE AND CABLE SUBCOMMITTEE

Considerable progress has been made by this group, under the chairmanship of W. S. Hay, with excellent co-operation from various manufacturer and user interests. J. A. Scott (M '34) and B. W. Jones (M '43) are preparing a paper, "Short Time Current Ratings for Aircraft Wire and Cable," for presentation before the Institute. This paper will give the results of a series of tests on AN-16 and AN-8 insulated aircraft cables to determine their permissible short time current capacity and will include tentative recommendations for short time current carrying capacity for aircraft cables, sizes AN-22 to AN-00.

### AIRCRAFT CARBON BRUSH SUBCOMMITTEE

Under the chairmanship of V. P. Hessler (F '43) this group is working actively on the preparation of a report on "Proposed Test Code for Aircraft Carbon Brushes." The subcommittee held its first meeting on January 24, 1946.

### REPORT ON AIRCRAFT D-C APPARATUS VOLTAGE RATINGS (AIEE STANDARD 700)

This proposed Standard has been out now for almost a year and the air transportation committee plans to circularize the aircraft industry and military services for comments so that action can be taken soon toward the completion of a regular Standard.

### ELECTRIC EQUIPMENT SAFETY SUBCOMMITTEE

A new subcommittee of the air transportation committee is to be formed to review available operating and test data which point to the type of electric equipment, methods of installation, and methods of operation which provide maximum safety in the performance of aircraft electric equipment, and to report concerning the desirability of committee action on this subject.

### NASC—STANDARD METHOD OF ELECTRICAL LOAD ANALYSIS FOR AIRCRAFT

With K. R. Smythe (M '44) as chairman, certain d-c graph and chart forms have

been prepared by the project committee and submitted for forwarding to the Aeronautical Board. These are intended for use in the preparation of an AN specification, of which they would form a part, outlining a standard method of making a d-c electrical load analysis for military and naval aircraft. Some work also has been done concerning an a-c electrical load analysis. This activity has been disrupted somewhat since the termination of the war due to changes in personnel but it is expected that it soon will be carried forward to completion.

SAE COMMITTEE A-2, AIRCRAFT ELECTRIC EQUIPMENT

Under the chairmanship of C. C. Shangraw the work of this group is continuing along the same general plan as set up and an earnest hope has been expressed that the AIEE will continue with its work and bring forth reports and Standards concerning aircraft electric equipment at an early date.

# SECTION......

## Gas Turbine Discussed Before Panhandle Section

Utilization of the many potential advantages offered by the gas turbine as a prime mover soon may be a realization according to an address before a recent meeting of the AIEE Panhandle Section in Amarillo, Tex. The speaker was John R. Carlson, an engineer with the Westinghouse Electric Corporation.

Mr. Carlson pointed out that the chief advantages of the gas turbine lie in its simplicity of design and operation, its compactness and relatively light weight. He predicted that, with the perfection of a reversible-pitch propeller to facilitate moving a ship either backward or forward, this prime mover next may be used to power ocean liners. Other uses might include its installation in locomotives; as auxiliary use on airplanes to provide lights, regulate wing flaps, and operate the landing gear; as central stations for provision of power for electric current; and as standby turbines to provide added power for heavily loaded distribution lines during busiest hours.

Any widespread use of the gas turbine as a central station power plant, however, depends upon economical operation. This factor was a detriment to progress for some time but war-stimulated research has resulted in the development of more durable metals which has made it possible to build up considerably more pressure within the turbine and, consequently, to concentrate more power into a smaller space. This trend leads to decreased original cost per turbine because of the fewer materials required for its manufacture as well as to reduced operating cost through better utilization of fuel.

# ABSTRACTS....

**TECHNICAL PAPERS previewed in this section will be presented at the AIEE North Eastern District meeting, Buffalo, N. Y., April 24–26, 1946 and will be distributed in advance pamphlet form as soon as they become available. Copies may be obtained by mail from the AIEE order department, 33 West 39th Street, New York 18, N. Y., at prices indicated with the abstract; or at five cents less per copy if purchased at AIEE headquarters or at the meeting registration desk.**

**Mail orders will be filled AS PAMPHLETS BECOME AVAILABLE**

## Air Transportation

**46-85-ACO—Electric Equipment for Cornell Variable-Density Wind Tunnel;** *C. C. Clymer (A '42), M. A. deFerranti (M'43). 25 cents.* Spectacular advances in airplane design during the past decade have created an increasing demand for additional testing facilities with which to obtain those data essential to successful design. To answer partially this demand and to facilitate more basic aerodynamic research on the subject of compressibility effects experienced in high-speed flight, several new wind tunnels were constructed during this same period. These tunnels vary widely in size and in requirements for air density and air speed in the tunnel working section. Correspondingly, the horsepower output requirements for their main fan-drive motors vary widely. But in all cases close speed regulation at preselected speed values over a wide range is essential to good test results. Most modern tunnels also incorporate suitable electric equipment for the operation of powered models and for the calibration of motors used in these models. This paper describes the Cornell variable-density wind tunnel from the viewpoint of electrical engineers and discusses principles governing the selection of electric equipment for wind tunnels.

**46-86—Electric Equipment Required in the Modern Six-Component Wind-Tunnel Balance System;** *H. O. Cox (A '35). 20 cents.* This paper describes how the electric equipment was built into a compact mechanical assemblage and points out a few of the unique problems that had to be handled in order that the balance systems could be installed in the variable-density wind tunnels at the Cornell Aeronautical Laboratory and the Southern California Co-operative Wind Tunnel. The primary elements of the balance system, the electric drive required for each, and the control system used for automatic following of the wind-shielding and image system all are described in good detail.

**46-87—Radiotelemetering for Testing Aircraft in Flight;** *C. L. Frederick (M '46). 30 cents.* A brief resume is given of the factors which necessitated the development of thoroughly practicable and reliable telemetering equipment for dynamic testing of high-speed aircraft in flight. An outline of a radiotelemetering system is presented which was developed under contract and accepted as suitable for structural flight testing by the United States Navy Bureau of Aeronautics in April 1945. Emphasis is placed on the electric system and circuits used which are of most interest to Institute members. These include the stabilized amplitude-modulated subcarrier oscillators, the frequency-modulated transmitter, the automatic-frequency-controlled frequency-modulation receiver, the heterodyne analyzer, and the mobile receiving station.

**46-89—Hit Indicator Equipment for Gunnery Training with Frangible Bullets;** *K. E. Burnham. 20 cents.* This paper deals with the development of equipment used to indicate and record the hits of frangible bullets on the surface of an armored pursuit aircraft. The aircraft, when modified and equipped, was used for training bomber gun crews in simulated combat aerial gunnery. The armor plate had to withstand the impact of the lead and plastic 30-caliber bullet. It was necessary to modify and use existing electronic equipment to record and indicate the hits on the aircraft surface. Later development work brought out a completely new indicating system custom-built to do the job.

## Basic Sciences

**46-84—Geometric Mean Distances for Rectangular Conductors;** *H. B. Dwight (F '26). 15 cents.* The geometric-mean-distance method of computing reactance is used a great deal with groups of round conductors. It would be useful also with rectangular conductors if values of geometric mean distance for such conductors were obtainable more readily. In this paper, curves for this quantity for rectangular conductors are given in such form that values can be determined conveniently with good accuracy for practical cases. Geometric mean distances can be used for computing the reactance of two rectangular bars forming a return circuit, no matter how close together the bars may be. The method is applicable also for 3-phase circuits and for cases where several conductors are in parallel. Two numerical examples are computed in detail.

## Electronics

**46-91—High Voltage Ignitron Rectifiers and Inverters for Railroad Service;** *J. L. Boyer (A '43), C. G. Hagensick (A '44). 30 cents.* This paper describes a new design of pumped ignitron type mercury-arc rectifier which has been developed for power conversion in the 3,000- to 4,000-volt range. These ignitrons were designed with emphasis on the heavy overload requirements of railroad service, which is the major application for this voltage class. The characteristics of power rectifier and inverter circuits are included to aid in determining the over-all performance. The design and test of two types of high voltage pumped ignitrons are described. The improved design for rectifier or inverter operation was obtained as a result of these tests.

## Industrial Control

**46-88-ACO—Application of the Electronic Oscillator to Measurement and Control;** *P. M. Hackett.* *20 cents.* This paper presents an electronic method to determine solution purity in a manner analogous to conductivity. No electrodes need contact the solution, however, and polarization and contamination effects are eliminated. Various other applications of radio frequency technique to industrial control problems also are presented and briefly summarized. A simple electronic circuit is given which will allow automatic power control from any industrial function that produces, or can be made to produce, a motion of matter. Control may be realized from almost any movement without contacting it or impeding its free motion. Examples of such motion are: movement of materials in level control applications, movement of mercury in a standard thermometer, mercury or other liquids in manometers. Mechanical motions, such as those of instrument pointers and expansion or stress movements, also may be detected, measured, and controlled within microscopic limits.

## Industrial Power Applications

**46-92-ACO—A Hot-Strip-Mill Flying-Shear Control Providing an Electric Tie Between Mill and Shear;** *J. E. Sowers (M '43), V. A. Leitzke (A '41).* *15 cents.* Increased production in the steel mill industry has placed more rigid requirements on all equipment. Satisfactory flying-shear performance requires a control which is flexible and accurate. Formerly controlled mechanically, the flying shear now has been successfully operated with an electric control system. The control utilizes a Ward Leonard system regulated by an amplidyne. A "coarse" speed control brings the "fine" speed control, which contains an electronic amplifier, into range, thus combining the flexibility of the amplidyne with the extreme sensitivity of the electronic control.

## Land Transportation

**46-90—Modern Double-Reduction Traction Motor;** *Lanier Greer (M '42).* *15 cents.* Incorporated in the modern double-reduction motor and gear unit are many new design features which have made it an outstanding motor for the past five years. Oil lubrication is provided for all gearing and bearings in the oiltight double-reduction gear unit. Special design constants, which have been developed as a result of many years of experience with high-speed motors are used. Self-ventilation is successful on a high-speed motor and simplifies locomotive design. Specially insulated field coils provide for good heat transfer from the coils to steel and air. A small motor with a high-speed armature results in low copper loss and high efficiency at high tractive effort. A steep speed curve with a large amount of field shunting makes it possible to use all motors connected permanently in parallel. The motor is small, compact, and lightweight, which has made possible its use on a wide range of locomotives.

## Power Generation

**46-100—Control of Frequency and Tie-Line Loads on the Niagara–Hudson System and Interconnected Systems;** *B. S. Rice (A '44).* *20 cents.* This paper covers equipment and methods used on the Niagara–Hudson system for the control of frequency and tie-line loads. A few operating problems are discussed together with planned extensions of these controls which will supplement and expand the present control system.

## Power Transmission and Distribution

**46-93-ACO—Incremental Transmission-Line Losses;** *W. D. Wilder (A '46).* *15 cents.* This paper will deal with a slide rule that has been developed to recognize incremental transmission losses as a supplement to incremental plant loading data. It is believed that results obtained are within 10 per cent of the true values, as results have been checked against a-c calculating board studies and fall within the foregoing limits. This slide rule has been so designed that incremental receiving end cost may be read directly, provided incremental production cost and initial transmission-line loadings are known.

**46-99-ACO—A 1,000-Kva Mobile Substation and Its Service Record;** *M. W. Bardwell (M '41).* *15 cents.* This paper describes the mobile substation which was designed to carry 1,000-kva primary and secondary load, with a tertiary winding capacity of 350 kva. The transformer primary voltages selected conform to the voltages of our low-voltage transmission systems. They are the 44, 33, 22, 13.2, and 11-kv systems from which by far the greater number of our smaller stations are supplied. Adequate transformer taps were provided to cover the operating range of voltages of each system. Primary 44- and 33-kv connections are Y, 22-kv connections optional Y or delta, and 13.2- and 11-kv delta. The secondary connections are for 2,300, 4,600-volt delta or 4,000-volt Y. The tertiary windings are arranged for 230- or 460-volt delta.

## Final Paper Abstracted for South West Meeting

The following abstract of a paper appearing on the technical program of the AIEE South West District meeting in San Antonio, Tex., April 16–18, 1946, was the only one not included in the list of abstracts published in the March issue of *Electrical Engineering*, page 130.

**46-82-ACO—Some Problems of Distribution Engineering;** *R. M. Walker (A '39).* *15 cents.* Rate reductions and increased taxes make it necessary to reduce system investment and operating costs. The distribution system offers the engineer an opportunity to meet these requirements. Standardization of four-wire Y distribution and joint use with communication lines, reduces investment and eliminates wire crossing conflicts. Simplification of rate schedules helps to simplify a distribution system. One service of not more than four wires should meet the requirements of any customer. Serving loads of more than 200 kw from the subtransmission circuit relieves the distribution substation and distribution feeders. The voltage at the customer's service point can be improved without undue investment by the application of regulators and capacitors. Package-type unit substations of 500-kva and 750-kva capacity, with five per cent plus and minus tap-changing, and with suitable switchgear below 50,000 kva, should be available for use in rural areas or where the interrupting capacity is low. Fault protection by the use of co-ordinated fusing and relays will reduce outages of distribution lines. Periodic field checking of all distribution transformer loading is necessary to assure economic installations, as well as to prevent overloading of apparatus.

# PERSONAL ● ● ● ●

**A. H. Wing, Jr.** (A '34, M '41) formerly electronics lecturer, Graduate School of Engineering, Harvard University, Cambridge, Mass., has been appointed associate professor of electrical engineering, Northwestern University Technological Institute, Evanston, Ill. Doctor Wing holds the degrees of bachelor of arts, bachelor of science, electrical engineer, and doctor of philosophy from Columbia University. He was associated with the General Electric Company from 1929 to 1932 at Schenectady, N. Y., and West Lynn, Mass., and in 1932 was made instructor in electrical engineering in the College of the City of New York. He joined the Harvard faculty in 1942, and has been on the staffs of the pre-radar school and the radio research laboratory. **R. R. Buss** (A '40) formerly research associate, Radio Research Laboratory, Harvard University, Cambridge, Mass., has been appointed assistant professor of electrical engineering, Northwestern Technological Institute. Doctor Buss was graduated from San Jose State College with the degree of bachelor of arts in 1935 and holds the degrees of electrical engineer and doctor of philosophy from Stanford University. Before becoming a member of the Harvard faculty in 1943 he was associated with the firms of Heintz and Kaufman, Ltd., San Francisco, Calif., and the Litton Engineering Laboratories, Redwood City, Calif. **J. A. M. Lyon** (A '38) until recently on active duty as a lieutenant in the United States Naval Reserve, has been appointed assistant professor of electrical engineering, North-

western Technological Institute. Doctor Lyon holds the degrees of bachelor of science, master of science, and doctor of philosophy from the University of Michigan. After brief periods with the Pittsburgh (Pa.) Reflector Company, the Metropolitan Edison Company, Reading, Pa., and the Utility Management Corporation, Reading, he joined the staff of Johns Hopkins University as instructor in electrical engineering in 1938. Before starting his naval service in 1943 he was assistant engineer with Ebasco Services, New York, N. Y.

**G. L. Weller** (M '26, F '31) formerly equipment and buildings engineer, Chesapeake and Potomac Telephone Company, Washington, D. C., has been made assistant chief engineer. Mr. Weller, who had been equipment and buildings engineer since 1929, joined the telephone company in Baltimore, Md., in 1901. His assignments have included application of standards, installation of pioneer public address systems, inventory, and appraisal work. He was appointed maintenance supervisor in 1927. He has been active in AIEE Washington Section affairs. **H. P. Howard, Jr.** (M '44) formerly plant extensions engineer of the Chesapeake and Potomac company, has been appointed equipment and buildings engineer. Mr. Howard received his bachelor of science degree from the United States Naval Academy in 1924. He has been with the Chesapeake company since 1935 as general traffic engineer, general traffic supervisor, and plant extensions engineer, which he was appointed in 1942. **E. R. Greenleaf** (A '39, M '45) transmission and outside plant engineer, Chesapeake and Potomac company, has been appointed plant extensions engineer. Mr. Greenleaf, who has been with the company since 1929, has been general traffic engineer and general traffic supervisor. He was made transmission and outside plant engineer in 1935.

**H. H. Scott** (A '32, M '38) formerly engineer in charge of acoustics, General Radio Company, Cambridge, Mass., is now president of the newly formed Technology Instrument Corporation, Waltham, Mass. Mr. Scott was graduated from Massachusetts Institute of Technology in 1930, received the degree of master of science in 1931, and in the latter year joined the General Radio Company as executive engineer. He has been responsible for the development of sound and vibration measuring equipment, frequency modulation and broadcast station monitoring equipment, and other radio frequency and audio measuring instruments. He has twice received the product design award of *Electrical Manufacturing* and is the author of a number of technical papers. **L. E. Packard** (A '40, M '41) formerly manager of the Chicago, Ill., office of the General Radio Company, is treasurer and in charge of sales in the new company. Mr. Packard, a 1935 graduate of Massachusetts Institute of Technology, joined the General Radio Company that same year. Since 1939 he had been manager first of the company's New York, N. Y., office and then of its Chicago office.

**M. L. Manning** (A '36, M '42) formerly assistant chief engineer, Kuhlman Electric Company, Bay City, Mich., has been appointed chief engineer. Mr. Manning holds the degrees of bachelor of science from South Dakota State College (1927) and master of science from the University of Pittsburgh (1932). He first joined the Westinghouse Electric Corporation, East Pittsburgh, Pa., as design engineer in 1929 and, after a period as instructor in mathematics at Pennsylvania State College in 1931 and 1932 and at the University of Pittsburgh from 1932 to 1936, returned to the Westinghouse company in 1936. He was titled research engineer in 1937 and later was Westinghouse lecturer at the University of Pittsburgh. In 1942 he became associate professor of electrical engineering at the Illinois Institute of Technology and in 1943 was appointed associate professor of electrical engineering and director of the new high voltage research laboratory at Cornell University, Ithaca, N. Y. He joined the Kuhlman company in 1945. Mr. Manning is a member of the Society for the Promotion of Engineering Education, the American Mathematical Society, and Sigma Tau and has been active in AIEE Section affairs.

**W. P. Schwabe** (A '96, M '24) manager of the northern division, Connecticut Light and Power Company, Thompsonville, has retired. Mr. Schwabe commenced his career with the Rutherford, N. J., Electric Light Company, which eventually was absorbed by the Public Service Corporation of New Jersey, from 1893 to 1908. In those years he rose from cadet engineer to superintendent of the electric department and district agent. In 1908 he joined the Northern Connecticut Light and Power Company as general manager and in 1915 became vice-president and general manager. He was also president and general manager of the Thompsonville Water Company and the Stafford Springs Aqueduct Company. After the Northern Connecticut company was acquired by the Connecticut Light and Power Company he became northern division manager. Mr. Schwabe was active in the National Electric Light Association and in the AIEE Connecticut Section.

**T. N. Lacy** (M '24, F '43) formerly vice-president and general manager, Michigan Bell Telephone Company, Detroit, is now president of that company. Mr. Lacy entered the long lines department of the American Telephone and Telegraph Company, Philadelphia, Pa., in 1906 following his graduation from Lehigh University. He became line inspector in 1909 and in that capacity was transferred to New York in 1911. He was sent to Atlanta, Ga., as division plant engineer in 1912 and became division plant superintendent in 1919. As division plant superintendent he went to the Michigan Bell company in 1925 and later that year became chief engineer. He was appointed vice-president and general manager and elected to the board of directors in 1934.

**F. W. Bush** (A '36, M '43) formerly assistant to the manager, electrical department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has been promoted to assistant manager. A graduate of the Georgia School of Technology with a bachelor of science degree in electrical engineering (1928), Mr. Bush has been associated with the company since 1928. He has been student engineer, assistant engineer in the transformer engineering department, engineer in charge of the high voltage laboratory, application engineer, and engineer in charge of transformer sales. In 1941 he became assistant to the manager of the electrical department.

**H. N. Muller, Jr.** (A '37, M '43) central station engineer, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been promoted to the position of manager of graduate student training. Mr. Muller, who was graduated from Dartmouth College with a bachelor of arts degree in physics (1935), has been with the Westinghouse company since his graduation. Entering the graduate student training course, he was assigned first to the materials and process engineering department and later was transferred to the central station engineering department. He is a member of the AIEE committee on power generation, 1944–47.

**E. H. Ginn** (A '03) commercial vice-president, General Electric Company, Atlanta, Ga., has retired from that position but will remain in an advisory capacity with the company until July 1, 1946. Mr. Ginn, who was born in Worcester, Mass., was graduated from the Worcester Polytechnic Institute in 1900. He joined the General Electric Company in 1901 and for a time was in the railway engineering department in Atlanta. In 1912 he was district manager of the railway and light department. He was made district sales manager in 1915, district manager in 1922, and was appointed commercial vice-president in 1936.

**R. P. Smith** (M '43) formerly general farm sales manager, Westinghouse Electric Supply Company, New York, N. Y., has become manager of the Midwest district of the company with headquarters at St. Louis, Mo. Mr. Smith, who has been with the company since 1923, first worked as sales correspondent and order clerk in the Baltimore, Md., plant and the Richmond, Va., branch and as salesman for the Miami, Orlando, and Jacksonville, Fla., branches. He was Florida division manager from 1933 to 1939, and was district apparatus and supply sales manager until May 1944, at which time he became chief

of the electrical section of the War Production Board, Washington, D. C. In 1945 he returned to the Westinghouse company as farm sales manager.

**Robert Paxton** (A '26, M '40) formerly manager of the Philadelphia (Pa.) works of the General Electric Company, has been made manager of the company's Pittsfield, Mass., works. Mr. Paxton entered the employ of the company in 1923 in the switchboard department, Schenectady, N. Y., after his graduation from Rensselaer Polytechnic Institute. He was transferred to the oil circuit breaker division at Philadelphia and in 1929 was made managing engineer of the metal enclosed division. He was named managing engineer of the panel and equipment division in 1932 and assistant to the manager in 1940. In 1941 he became manager of the Philadelphia works.

**A. L. Thurman** (A '38, M '45) application engineer, General Electric Company, Schenectady, N. Y., since 1941, has been appointed chief electrical engineer, Aetna-Standard Engineering Company, Youngstown, Ohio. He holds from the Oklahoma Agricultural and Mechanical College a bachelor-of-science degree in electrical engineering (1936), bachelor-of-science degree in mechanical engineering (1937), and a master-of-science degree in electrical engineering (1937). Mr. Thurman was research assistant and part-time instructor at the Oklahoma college before going to the General Electric Company in 1937.

**S. F. Butler** (A '23) member of technical staff, Bell Telephone Laboratories, Inc., New York, N. Y., retired in 1945 after spending 45 years in the service of the company. A native of Marlboro, Mass., Mr. Butler went to work for the New England Telephone Company in the engineering department, Boston, Mass., in 1900. Subsequently, he was with the Western Electric Company at Hawthorne, Ill., and in 1919 went to the Bell Telephone Laboratories in New York. In 1921 he was placed in charge of the current development and trial installation group and later became switching equipment engineer.

**H. S. Dusenbery** (A '44) formerly supervisor, electrical production control, Moore Dry Dock Company, Oakland, Calif., has been appointed to the college of engineering, University of Santa Clara (Calif.) where he will conduct a number of courses in electrical engineering. Mr. Dusenbery, a graduate of the University of California with a bachelor-of-science degree in electrical engineering (1917), was associated at one time with the Pacific Gas and Electric Company, San Francisco, Calif. He is co-author of "Practical Marine Electricity."

**D. B. Smith** (A '35) director of research, Philco Corporation, Philadelphia, Pa., since 1941, has been appointed vice-president in charge of engineering. Mr. Smith, a native of Newton, N. J., received a bachelor-of-science degree from Massachusetts Institute of Technology (1933) and a master of science degree in electrical engineering (1934). In the latter year he joined the Philadelphia Storage Battery Company as a member of the engineering department. He has served as a patent engineer on radio, television, and other applications of electronics. He was appointed technical consultant to the vice-president in charge of engineering in 1938, and was promoted to director of research in 1941.

**Paul MacGahan** (A '02, F '42) recently retired development engineer, Westinghouse Electric Corporation, Newark, N. J., now is engaged in private consulting practice in Woodstock, N. Y. A graduate of Columbia University (1896) with a degree in electrical engineering, Mr. MacGahan became associated with the Westinghouse company in 1897. He has served on the following AIEE committees: protective devices, 1918–20; instruments and measurements, 1922–24, 1930–45; and technical program, 1931–33.

**J. M. Cage** (M '44) engineer in charge, electronic devices section, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. has been appointed manager, industrial electronics division, Raytheon Manufacturing Company, Waltham, Mass. A graduate of Iowa State College, Mr. Cage first worked for the General Electric Company, Schenectady, N. Y., and before joining Allis-Chalmers Manufacturing Company in 1943 served as associate professor, department of electrical engineering, University of Colorado, Boulder, for four years.

**E. H. Mittanck** (A '28, M '40) engineer, Southwestern Bell Telephone Company, Dallas, Tex., and more recently lieutenant colonel, Army of the United States, has returned to the Southwestern Bell Telephone Company. A graduate of the Texas Agricultural and Mechanical College (1927) with a bachelor-of-science degree in electrical engineering, Colonel Mittanck joined the staff of the Southwestern Company in 1927.

**C. M. Lynge** (M '22) assistant works manager, General Electric Company, Bridgeport, Conn., was appointed manager there effective January 1, 1946. He will continue as assistant manager of manufacturing of the appliance and merchandise department at Bridgeport. Mr. Lynge has been associated with the General Electric Company since 1913 and has served successively as design engineer, in the cost and production department, and on motor manufacture in Pittsfield, Mass. He transferred to Bridgeport in 1920.

**J. E. O'Brien** (A '29, M '39) formerly major, United States Marine Corps Reserve, and chief of the experimental section, Marine Corps Equipment Board, Quantico, Va., has been appointed principal engineer of the newly created new development section of the Rural Electrification Administration. Following his graduation from the Catholic University of America in 1927, Mr. O'Brien remained at the university as assistant instructor, and assistant professor of electrical engineering. He joined the REA in 1940 and was head of the Special Problem Section, Technical Standards Division when he was called to active duty in 1942. He is a past chairman of the AIEE Washington Section.

**W. E. Keith** (A '25) formerly personnel staff assistant, New England Telephone and Telegraph Company, Boston, Mass., has been appointed general employment and training supervisor. Mr. Keith entered the Bell system as student engineer with the Bell Telephone Company of Pennsylvania, Philadelphia, in 1922 after his graduation from Worcester Polytechnic Institute. He was transferred to the New England company in 1923 and since has served as director of college relations, exchange rate engineer, general commercial training supervisor, and branch manager. He was appointed assistant to the vice-president in 1939 and personnel staff assistant in 1944.

**A. D. Pettee** (A '20, M '37) formerly technical superintendent, General Cable Corporation, Bayonne, N. J., has been appointed chief electrical engineer of the company. Mr. Pettee, who was born in Andover, Mass., in 1889, holds the degrees of bachelor of arts from Yale University and bachelor of science from Massachusetts Institute of Technology. His first position was assistant electrical engineer with the International Harvester Corporation, Chicago, Ill., in 1919. From 1921 to 1929 he was assistant distribution engineer with the New York (N. Y.) Edison Company. Since 1929 he has been with the General Cable Corporation as cable engineer, sales engineer, consulting engineer, and district sales engineer. He was appointed technical superintendent in 1943.

**W. E. Beaty** (A '11) electrical engineer, Cincinnati (Ohio) Gas and Electric Company, has retired. Mr. Beaty joined the Cincinnati company in 1901 as meter reader and repairman, became head of that department, and was transferred to the engineering department as assistant to the department head. In 1910 he was appointed assistant superintendent of electric distribution, and, when the Columbia Engineering and Management Corporation was formed in 1923, he was transferred to that corporation to take charge of electric transmission and distribution work. He rejoined the Cincinnati company in 1930 and since had been working on estimates and budget control for the electric distribution department.

**F. E. Sanford** (A '28, M '34) formerly superintendent of distribution engineering, Cincinnati (Ohio) Gas and Electric Company, has become Western editor for *Electrical World*. Mr. Sanford had been with the Cincinnati company since his graduation from the University of Cincinnati in 1922. He served as transmission engineer and distribution engineer, and recently had supervised construction layout, transformer operation, voltage control, right of way, load analysis, and system planning. He has served on Edison Electric Institute and AIEE committees and is the author of "Electric Distribution Fundamentals." He is a member of the Engineering Society of Cincinnati and a past president of the Technical Societies Council of Cincinnati.

**C. S. Bowden** (M '42) formerly supervising engineer, Ohio Public Service Company, Elyria, is now production manager and assistant to the vice-president in charge of operations. Mr. Bowden, who was graduated cum laude from the University of Colorado in 1923, has been with the Ohio company since 1925 and before that was associated with the Public Service Company of Colorado, Denver, and the City Light and Water Company, Amarillo, Tex. **M. A. Giles** (A '39) formerly service manager, distribution department, Ohio Public Service Company, Mansfield, has been placed in charge of the central engineering department at Elyria. Mr. Giles, a 1922 graduate of the University of Wisconsin, joined the company in 1926.

**D. R. Edge** (A' 44) formerly manager of the Central Electric Co-operative, Inc., Parkers Landing, Pa., has been appointed assistant rural lines sales manager for the Graybar Electric Company, Inc., Chicago, Ill. Since 1936 Mr. Edge has been active in Rural Electrification Administration work, managing the Union Rural Electric Co-operative, Marysville, Ohio, before he organized the Central Electric Co-operative. Previously Mr. Edge had been with the General Cable Corporation, New York, N. Y., for four years.

**H. D. Larrabee** (A '06) eastern division manager, Connecticut Light and Power Company, Willimantic, has retired. Mr. Larrabee was graduated from the Massachusetts Institute of Technology in 1902 and was employed by the General Electric Company and by utilities in Puerto Rico, Illinois, Indiana, and Vermont before 1919, in which year he went to Norwich as manager of the Eastern Connecticut Power Company. In 1929 he became eastern division operating superintendent of the Connecticut Light and Power Company which acquired the Eastern Connecticut company at that time.

**J. K. Hodnette** (A '25, F '42) formerly manager of engineering, engineering department, transformer division, Westinghouse Electric Corporation, Sharon, Pa., has been made manager of the transformer division. A 1922 graduate of the Alabama Polytechnic Institute, Mr. Hodnette has been with the Westinghouse corporation since his graduation. He was laboratory assistant at the East Pittsburgh, Pa., works until 1924. At that time he was transferred to Sharon. Mr. Hodnette was named a modern pioneer of industry in 1940 by the National Association of Manufacturers.

**A. L. Jones** (A '07, F '38) commercial vice-president, General Electric Company, Denver, Colo., has retired. Mr. Jones, who was born in Ballston, N. Y., was graduated from Cornell University in 1904 and that year started his career in the testing department of the General Electric Company. After some experience in the power mining engineering department, he was transferred to Denver as district engineer in 1909. He was appointed assistant district manager in 1926 and district manager in 1928. He had been commercial vice-president since 1936.

**H. D. Moreland** (A '35, M '41) formerly manager of X-ray engineering, Westinghouse Electric Corporation, Baltimore, Md., has been made manager of the company's X-ray division in Baltimore. Mr. Moreland, who holds the degrees of bachelor of science and master of science in electrical engineering from the Oregon State College, joined the Westinghouse company as an X-ray serviceman in Portland, Oreg., in 1933. He was transferred to San Francisco, Calif., as salesman in 1935 and returned to Portland as X-ray manager in 1938. From 1942 until he went to Baltimore in 1944, he was manager of X-ray products in East Pittsburgh, Pa.

**W. A. Kelley** (A '38) lieutenant colonel, Army Signal Corps, Lexington, Ky., recently was awarded the Legion of Merit. The citation states that Colonel Kelley who was commanding officer of the Stock Numbering Agency was responsible for classifying, cataloging, stock numbering, and code numbering all items of Signal Corps equipment and supplies. Prior to his active duty with the Army, Colonel Kelley served with the War Production Board, of which he organized seven divisions. During his Army service his book, "The Universal Catalog System," was published.

**W. C. Wagner** (A '06, F '41) formerly general superintendent, meter division, Philadelphia (Pa.) Electric Company and more recently a captain, United States Naval Reserve, has returned to his former position. Called to active duty as a lieutenant commander in 1941, he was commissioned captain in 1945. He served as research engineer, head of the research section, and head of the electricity section of the research and standards branch of the Bureau of Ships, Washington, D. C.

**L. E. Williams** (A '41) formerly assistant professor of electrical engineering, University of Pittsburgh, Pittsburgh, Pa., has been appointed assistant professor of electrical engineering at the University of Connecticut, Storrs, from which he was graduated in 1940. Professor Williams also was employed for a time by the Westinghouse Electric Corporation, East Pittsburgh, Pa. He is a member of Eta Kappa Nu and Sigma Tau.

**H. B. McIntyre** (M '38) formerly toll rate engineer, New England Telephone and Telegraph Company, Boston, Mass., has been appointed general rate engineer of the company. Mr. McIntyre was graduated from Colby College in 1920 and from Massachusetts Institute of Technology in 1922. He joined the company in 1924 as division commercial assistant, became rate engineer in 1929, and assistant exchange rate engineer in 1935. He has been toll rate engineer since 1941.

**W. B. Clayton** (M '40) commercial vice-president, General Electric Company, Dallas, Tex., adds responsibility for the company's territory of Denver, Colo., and its environs to his duties. **A. S. Moody** (A '09) commercial vice-president, General Electric Company, Portland, Oreg., assumes the additional responsibility of the territory from Butte, Mont., westward.

**Clarence Arnott** (A '27, M '43) formerly assistant superintendent, engineering division, electrical department, British Columbia Electric Railway Company, Ltd., Vancouver, Canada, is now assistant general superintendent of the company. Mr. Arnott was graduated from the University of British Columbia in 1929 and has been associated with the British Columbia Railway company as draftsman, assistant engineer, assistant valuation engineer, and since 1941 as assistant superintendent of the engineering division.

**C. L. Richardson** (M '44) major, Canadian Royal Corps of Signals, has been appointed inspector of Signals Division, Directorate of Signals and Engineering, Inspection Board of United Kingdom and Canada, with headquarters in Ottawa, Ontario. Major Richardson was chief radio engineer for the Canadian General Electric Company, Toronto, from 1924 to 1928 and afterwards was consultant for many sound and film companies. He was called to active duty as a captain in 1940.

**F. W. Tatum** (A '42, M '45) formerly engineer, American District Telegraph Company, New York, N. Y., has been appointed engineering supervisor. Mr. Tatum was graduated from Columbia University in 1935 and thereupon joined the plant department of the American District Telegraph Company. He entered the engineering department in 1936 and since 1944 has been in charge of the electronics training courses for company personnel.

**I. A. Terry** (A '27, F '37) formerly assistant to the vice-president, apparatus department, General Electric Company, Schenectady, N. Y., has transferred to the Fort Wayne (Ind.) Works of the company as works engineer. He was a member of the AIEE board of examiners, 1944–46.

**W. M. McKie** (A '41) formerly in the engineering department, Canadian General Electric Company, Limited, Peterborough, Ontario, and more recently retired as flight lieutenant, Royal Canadian Air Forces, has joined the switchgear section, central station division, apparatus department, Canadian General Electric Company.

**C. F. Kettering** (A '04, F '14) vice-president in charge of research, General Motors Corporation, Dayton, Ohio, received an honorary membership in the American Society of Civil Engineers at its recent annual meeting in New York, N. Y. Mr. Kettering won the Washington Award in 1936, and the John Fritz Medal in 1944.

**R. H. Snyder** (A '38) formerly of Cranford, N. J., has been appointed general sales manager of the Hertner Electric Company, Cleveland, Ohio, subsidiary of General Precision Equipment Corporation, New York, N. Y. Mr. Snyder was graduated from New York University in 1933 with a bachelor-of-science degree in electrical engineering.

**H. L. Olesen** (M '27) sales promotion manager, Weston Electrical Instrument Corporation, Newark, N. J., is now general sales manager. An electrical engineering graduate of the University of Illinois (1918), Mr. Olesen has been associated with the Weston company since 1931 and has been in charge of radio sales, assistant general sales manager, and sales promotion manager.

**E. E. Hill** (A '16) formerly associate manager, electric production department, Consolidated Edison Company of New York (N. Y.), Inc., has been appointed executive assistant to the executive vice-president. Mr. Hill entered the employ of the New York Edison Company in 1904 and filled all positions in the meter department from assistant meter tester to general foreman.

**C. M. Veronda** (A '43) until recently a member of the staff of the Naval Research Laboratory, Boston, Mass., is now assistant engineer, microwave section, Philips Laboratories, Inc., Irvington, N. Y. Mr. Veronda was graduated from the California Institute of Technology in 1942 and before entering the Navy was employed in the heating device engineering department of the General Electric Company, Bridgeport, Conn.

**W. F. Wolfner II** (A '41) formerly major in the Army Signal Corps, has been appointed director of audiovisual engineering, Jordanoff Electronics Corporation, New York, N. Y. Before the war Mr. Wolfner, a 1938 graduate of the University of Michigan, was associated with the Electronics Control Corporation, Detroit, Mich., and with Photoswitch, Inc., Cambridge, Mass.

**C. J. Nevitt** (A '33) formerly assistant superintendent, San Diego (Calif.) Gas and Electric Company, has been made superintendent. After his graduation from the University of California in 1931, Mr. Nevitt was associated with the San Joaquin Light and Power Company, Fresno, Calif. He moved to San Diego in 1932 and was employed in the city's water utility evaluation and engineering department. In 1936 he joined the San Diego company's engineering department, and in 1945 he was made assistant superintendent of the electric transmission and distribution department.

**W. J. Mann, Jr.** (M '43) formerly vice-president, Wolfe and Mann Manufacturing Company, Baltimore, Md., is now president of the company. Mr. Mann was graduated from the University of Virginia in 1910 and for eight years afterwards was associated with the Westinghouse Electric Corporation, East Pittsburgh, Pa. Following brief periods with Bartlett Hayward Company, Baltimore, and the Standard Electric and Elevator Company, Baltimore, he became vice-president of The Wolfe and Mann company in 1922.

**W. H. Snowden** (A '37) formerly major, United States Army, has returned to *Electrical West* as engineering editor. He was ordnance executive officer of the Third Infantry Division which was in action in Africa, Sicily, Italy, and France. He was awarded the Legion of Merit for activity in the Sicilian and Italian campaigns and later received an oak leaf cluster for outstanding work on the War Department general staff, to which he was attached in 1944 and 1945.

**A. L. Kerrigan** (A '30, M '39) formerly lieutenant colonel, United States Army, has returned to the Fitchburg (Mass.) Gas and Electric Company as general superintendent. Mr. Kerrigan, who was graduated from Massachusetts Institute of Technology in 1921, previously was associated with the New York (N. Y.) Edison Company, the Westinghouse Lamp Company, Bloomfield, N. J., and Charles H. Tenney and Company, Boston, Mass. He joined the Fitchburg company in 1936.

**N. E. Wilson** (A '38) formerly assistant professor of electrical engineering, Thayer School of Engineering, Dartmouth College, Hanover, N. H., has been appointed Westinghouse fellow at the Illinois Institute of Technology, Chicago, for the year 1945–46. The fellowship provides for a year of study in power systems engineering and work on the a-c network calculating board. A Cornell University graduate, Mr. Wilson was employed by the Westinghouse Electric Corporation after his graduation in 1937 and later was instructor at the University of Maine.

**A. S. Glasgow** (A '08) superintendent of the transmission and distribution department, San Diego (Calif.) Gas and Electric Company, has retired. Mr. Glasgow was born in Bellwood, Pa., in 1878, and was graduated from Pennsylvania State College in 1901. That same year he joined the General Electric Company and in 1903 was transferred to its San Francisco office, and the following year to Los Angeles, Calif. In 1916 he entered the employ of the San Diego Company as its first district agent at Oceanside, Calif. In 1928 he was transferred to San Diego.

**J. E. Teckoe** (M '29) manager of the Hydro-Electric Commission of Niagara Falls, Ontario, Canada, has retired. Mr. Teckoe was born in 1874 in Shrewsbury, England, and prior to his becoming manager of the Hydro-Electric Commission of Niagara in 1921 had been superintendent of the Hydro-Electric System of Tillsonbury, Ontario, from 1913 to 1921. Mr. Teckoe was electrician to the Town of Strathroy, Ontario, in 1906, and to the town of Powassan in 1909. In 1911 he became electrician and manager of the town of Ayr, Ontario.

**R. V. Hartley** (A '16, M '23) research consultant, research department, Bell Telephone Laboratories, Inc., New York, N. Y., was awarded the medal of honor of the Institute of Radio Engineers, New York, at its annual meeting January 24, 1946. **P. C. Goldmark** (M '45) chief television engineer, Columbia Broadcasting System, Inc., New York, was the recipient of the IRE Morris-Liebmann Memorial Prize.

## OBITUARY

**Irving Thompson Faucett** (A '11, F '28) chief engineer, General Cable Corporation, New York, N. Y., died January 16, 1946. Mr. Faucett was born May 12, 1885, in Stamford, Conn., and studied at Cooper Union Institute. He commenced his electrical career in 1905, gaining experience in several firms in Stamford and New York, including the Western Electric Company, the Westinghouse Electric Corporation, and the Brooklyn Edison Company. In 1911 he joined the Safety Insulated Wire and Cable Corporation as assistant foreman of tests and in 1913 became foreman of tests. He advanced to standard practice engineer in 1920 and chief engineer in 1923. In 1928 he became superintendent and later manager of the company's Bayonne, N. J., plant. He became vice-president in 1929 and then director of high-voltage engineering for the General Cable Corporation of which the Safety Cable Company had become a division. He was named consulting engineer in

1933, product sales manager in 1938, and chief engineer in 1940. Mr. Faucett was chairman of several committees of the Insulated Power Cable Engineers Association and was coauthor of a number of articles.

**John Napier Wallace** (M '14, F '20) managing director, Equipment, Ltd., Wellington, N. Z., died November 4, 1945. Mr. Wallace was born September 2, 1883, in London, England, and was graduated from the Chicago Manual Training School in 1899. The year of his graduation he entered the employ of the Western Electric Company, Chicago, Ill. During 1903 he served in the central office and the equipment engineering department in New York and in 1904 returned to Chicago. In 1905 he was placed in charge of the experimental and circuit laboratories. He joined the Vote Berger Company, La Crosse, Wis., as assistant chief engineer in 1907 and a year later was appointed chief engineer and superintendent. Returning to the Western Electric Company in 1910, he traveled to Berlin, Germany; Antwerp, Belgium; and Australia and New Zealand in connection with the construction of automatic telephone plants in those countries. After 1914 he remained in New Zealand at first with the Western Electric Company and later with Equipment, Ltd. From 1931 to 1933 Mr. Wallace served on the Wellington City Council. He was a member of the New Zealand Institute of Engineers and had a number of patents issued in his name.

**Charles Porterfield Kahler** (A '10, M '23) chief electrical engineer, Union Pacific Railroad Company, Omaha, Nebr., died February 25, 1946. Born November 25, 1880, in Baltimore, Md., Mr. Kahler received the degree of civil engineer from the University of Notre Dame. He also studied at Baltimore City College, Maryland Institute, and Alexander Hamilton Institute. After his graduation in 1903 he remained at Notre Dame University, South Bend, Ind., as instructor and assistant professor. From 1904 to 1906 he was assistant engineer for the Chicago and St. Louis Railway, Cleveland, Ohio. In 1906 he entered the Union Pacific system as assistant to the chief engineer of the Oregon Short Line Railroad, Salt Lake City, Utah, and in 1912 was named electrical engineer. About 1932 he was transferred to Omaha as system electrical engineer, and in 1939 he was appointed chief electrical engineer. Mr. Kahler was a former chairman of the AIEE Nebraska Section and had served on the AIEE committees on membership and land transportation. He also was a member of the American Society of Civil Engineers and the Association of Electric Railway Engineers and the author of several papers.

**Wilbur Cover Thomas** (A '24, M '39) toll plant extension engineer, Southern California Telephone Company, Los Angeles, died February 27, 1946. Mr. Thomas was born May 8, 1897, in Georgetown, Colo., studied at Princeton University and received the degree of bachelor of science in electrical engineering from Throop College of Technology in 1918. Mr. Thomas served in World War I as a lieutenant in the Signal Corps and afterwards was overseas representative in China for the Standard Oil Company. Returning to the United States in 1921, he joined the Southern California Company and was engaged in exchange transmission design work until 1928. In that year he was placed in charge of toll transmission design work. He was a member of Tau Beta Pi and the Telephone Pioneers of America.

**Leslie Elson Ross** (A '29) general superintendent and vice-president, Niagara Falls (N. Y.) Power Company, died December 22, 1945. Born January 28, 1885, Mr. Ross had been associated with the company and its predecessors for about 45 years. He commenced his career as a lineman's helper for the Hydraulic Power and Manufacturing Company. He was made operating superintendent by the Niagara Falls Company in 1924 and general superintendent in 1929. He was given the additional duties of general superintendent of generation and transmission of the Buffalo, Niagara, and Eastern Power Corporation in 1934. In 1941 he was appointed vice-president.

# MEMBERSHIP . . .

## Recommended for Transfer

The board of examiners, at its meeting of March 21, 1946, recommended the following members for transfer to the grade of membership indicated. Any objections to these transfers should be filed at once with the secretary of the Institute.

### To Grade of Fellow

Bush, R. M., major, Corps of Engineers, U. S. Army, Atlanta, Ga.
Butler, J. W., sponsor engr., cent. station engg. div., General Elec. Co., Schenectady, N. Y.
Chute, G. M., application engr., General Elec. Co., Detroit, Mich.
Dean, S. M., chief engr. of system, Detroit Edison Co., Detroit, Mich.
Foltz, L. S., prof. of elec. engg., Michigan State College, E. Lansing, Mich.
Gault, J. S., assoc. prof. of elec. engg., Univ. of Michigan, Ann Arbor, Mich.
Knickerbocker, W. G., supt. of meters, Detroit Edison Co., Detroit, Mich.
Ostline, J. E., systems dev. engr., Automatic Elec. Co., Chicago, Ill.

8 to grade of Fellow

### To Grade of Member

Alger, C. S., assoc. engr., Puget Sound Power & Light Co., Seattle, Wash.
Balfour, M. W., assoc. engr., Consumers Power Co., Jackson, Mich.
Blackett, H. W., plant elec. engr., Canadian Westinghouse Co. Ltd., Hamilton, Ont., Can.
Bowlus, O. E., project engr., Chrysler Corp., Detroit, Mich.
Bradley, J. J., asst. supt. of elec. installations, General Elec. Co., Philadelphia, Pa.
Buck, D. H., lieutenant (jg), U. S. Navy Dept., Bureau of Aeronautics, Washington, D. C.
Cain, B. M., engg. asst., General Elec. Co., Lynn, Mass.
Carr, B. P., assoc. engr., Consumers Power Co., Jackson, Mich.
Emery, W. L., radio engr., dept. of elec. engg., Iowa State College, Ames, Iowa
Ennis, B. J., elec. engr., Burns & McDonnell Engg. Co., Kansas City, Mo.
Erickson, W. H., asst. prof., elec. engg. dept., Cornell Univ., Ithaca, N. Y.
Fleming, W. R., maint. engr., electrical, Chicago District Elec. Generating Corp., Chicago, Ill.
Foley, R. J., supt., elec. distribution, Public Service Board, San Antonio, Tex.
Goodell, P. H., ind. heating engr., Trumbull Elec. Mfg. Co., Norwood, Ohio
Grundel, W. W., engg. representative, Elec. Storage Battery Co., San Francisco, Calif.
Haupt, L. M., prof. of elec. engg., A. & M. College of Texas, College Station, Tex.
Hess, H. M., assoc. prof. of elec. engg., Wayne University, Detroit, Mich.
Hurlbut, H. C., sr. elec. engr., Supervisor of Shipbuilding, USN, Seattle, Wash.
Johnson, E. M., engr., General Elec. Co., Seattle, Wash.
Kinsey, J. F., distribution engr., Public Service Elec. & Gas Co., Hackensack, N. J.
Litman, S., assoc. prof. of elec. engg., Univ. of South Carolina, Columbia, S. C.
Matthews, A. H., chief distribution engr., Ohio Power Co., Canton, Ohio
Mayer, L. F., electrical design engr., United Engineers & Constructors, Philadelphia, Pa.
McCandless, W. H., elec. engr., AAF Technical Service Command, Wright Field, Dayton, Ohio
McCart, S. O., dist. meter & instrument specialist, General Elec. Co., Cleveland, Ohio
McCloska, F. W., elec. engr., Sargent & Lundy, Chicago, Ill.
McIntire, R. L., supt., Shawnee Div., Oklahoma Gas & Elec. Co., Shawnee, Okla.
McNair, I. M., analysis engr., system planning dept., Pennsylvania Power & Light Co., Allentown, Pa.
Mohaupt, E. E., elec. engr., Harnischfeger Corp., Milwaukee, Wis.
Morgan, J. S., engr.-in-chge., switchgear sales, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Mouromtseff, I. E., asst. to mgr., electronics engg. dept., Westinghouse Elec. Corp., Bloomfield, N. J.
Munzer, L. F., major, Air Corps, U. S. Army, Pacific Div., Air Transport Command, San Francisco, Calif.
Norell, E. G., elec. engr., Sargent & Lundy, Chicago, Ill.
Oehrig, H. B., resident engr., E-J Elec. Installation Co., Jeffersonville, Ind.
Pollard, C. L., sr. engr., engg. dept., Pennsylvania Power & Light Co., Allentown, Pa.
Pratt, W. E., asst. overhead engr., Memphis Lt. Gas & Water Div., Memphis, Tenn.
Road, R. A., chief engr., Duncan Elec. Mfg. Co., Lafayette, Ind.
Robinson, J. M., elec. engr., North Elec. Mfg. Co., Galion, Ohio
Roehm, F. J., elec. engr.-designer, American Machine & Foundry Co., Brooklyn, N. Y.
Ryder, J. D., prof. of elec. engg., Iowa State College, Ames, Iowa
Shaad, P. E., elec. engr., Sacramento Municipal Utility District, Sacramento, Calif.
Smith, W. T., assoc. engr., Rural Electrification Administration, Washington, D. C.
Snead, S. R., erection engr., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Summers, I. A., captain, AC, AAF Liaison Officer, Radio Research Lab., Harvard Univ., Cambridge, Mass.
Thomas, E. A., testing engr. & meter supt., Walsall Corp., Elec. Supply Dept., Walsall, Staffs, England
Thrithart, J., field engr., General Elec. Co., St. Louis, Mo.
Tracht, P. A., laboratory director, Evans Products Co., Detroit, Mich.
Troche, H., field service engr., Westinghouse Elec. Corp., Milwaukee, Wis.
Waddell, J. D., asst. operating mgr., electric, Delaware Power & Light Co., Wilmington, Del.
West, B. C., lt. comdr., USNR, Puget Sound Navy Yard, Bremerton, Wash.
Wood, M. L., head, elec. equip. section, Cornell Aeronautical Lab., Buffalo, N. Y.

51 to grade of Member

## Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Any member objecting to the election of any of these candidates should so inform the secretary before May 15, 1946, or July 15, 1946, if the applicant resides outside of the United States or Canada.

### To Grade of Member

Anderson, G. H., Rural Electrification Adm., Washington, D. C.
Anderson, L. W. W., Messrs. Veritys Ltd., Birmingham, England

Aspden, R. L., Royal Aircraft Establishment, Farnborough, Hants, England
Armstrong, W. B., Capt., USNR, Bureau of Ships, Navy Dept., Washington, D. C.
Baker, W. R., Atlantic Coast Line Railroad Co., Wilmington, N. C.
Brasfield, C. T., Jr., Alabama Power Co., Birmingham, Ala.
Bray, V. H., Air Ministry, West Drayton, Middlesex, England
Burrier, E. R. (re-election), Hudson Coal Co., Scranton, Pa.
Campbell, C. F., Puebla Tramway Light & Power Co., Puebla, Mexico
Carlock, L. H., Jr., TVA, Jackson, Tenn.
Cope, R. R., Aluminum Co. of America, New Kensington, Pa.
Court, E. T., The Radio Gramophone Development Co., Bridgnorth, Shropshire, Eng.
Dabney, T. S., General Electric Co., Beaumont, Tex.
Decker, H. J., General Motors Corp., La Grange, Ill.
Double, C. R., Bonneville Power Adm., Portland, Oreg.
Erickson, E. H., Public Service Elec. & Gas Co., Newark, N. J.
Gilcrease, O. E., Tennessee Eastman Corp., Oak Ridge, Tenn.
Giorgi, L., General Rio Negro Hydro Development, Montevideo, Uruguay
Hall, W. C., Naval Research Lab., Anacostia Sta., Washington, D. C.
Hansen, P. B. (re-election), Graybar Elec. Co., Inc., Minneapolis, Minn.
Harrison, A. M., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Havart, R. F., Govt. of Bahamas Elec. Dept., Nassau, Bahamas, B. W. I.
Hill, T. H., Ferranti Electric Ltd., Toronto, Ont., Can.
Hommel, R. W., War Dept., Wright Field, Dayton, Ohio
Howard, D. J., Cornell Aero. Lab., Buffalo, N. Y.
Kirk, C. H., Kellex Corp., New York, N. Y.
Leatham, W. T., Consumers Power Co., Jackson, Mich.
Lugque, E. D., Industria Electrica de Mexico, S. A., Mexico City, Mexico
Manahan, F. T., Albert Kahn, Assoc. Architects & Engineers, Inc., Detroit, Mich.
Mathieu, H. P., Cabot Shops, Inc., Pampa, Tex.
McKay, J. W., Tampa Elec. Company, Winter Haven, Fla.
Merritt, A. O., Humber-Hillman Co. Ltd., Stoke, Coventry, England
Metcalf, C. N., Consolidated Edison Co. of New York, New York, N. Y.
Miller, F. G., Cruft Lab., Harvard University, Cambridge, Mass.
Miller, G. B., Duquesne Light Co., Pittsburgh, Pa.
Myers, V. E., Cutler Hammer, Inc., Milwaukee, Wis.
Richards, R. T., Central Arizona Light and Power Co., Phoenix, Ariz.
Sarault, G. E., Université Laval, Quebec, P. Q., Canada
Sharpless, H. R., Sr., Gulf Oil Corp. Refinery, Port Arthur, Tex.
Swartzel, K. D., Cornell Aeronautical Lab., Cheektowoga, N. Y.
Taylor, J. D., Alden Park Manor, Philadelphia, Pa.
Tantawi, M. K. M., Eastern Elec. Co., Cairo, Egypt
Teach, E. E., Ingersoll-Rand Co., Painted Post, N. Y.
Varma, R. P., The Gaya Electric Supply Co. Ltd., Gaya, Bihar, India
Walmsley, F. C., The Micanite and Insulators Co., Ltd., Walthamstow, London, England
Wang, N. W., Natl. Resources Comm. of China Technical Office, New York, N. Y.
Weichel, T. R., U. S. Bureau of Mines, Mount Hope, W. Va.
Woodward, W. B., The Ohio Bell Tel. Co., Cleveland, Ohio
Worstell, R. E., General Elec. Co., New York, N. Y.
Wunenburger, G., Buenos Aires University, Buenos Aires, S. A.
Zak, S. J., Wright Field, Dayton, Ohio

51 to grade of Member

## To Grade of Associate

### United States and Canada

1. North Eastern

Bliss, J. A., W. S. Rockwell Co., Fairfield, Conn.
Bloom, J. H., Sylvania Electric Products, Inc., Boston, Mass.
Ciaschini, W. A., General Elec. Co., Pittsfield, Mass.
Cochran, J. L., General Elec. Co., Schenectady, N. Y.
Davies, A. E., Cornell University, Ithaca, N. Y.
Dawson, C. H., University of Rochester, Rochester, N. Y.
Dodge, P. T., Aluminum Co. of America, Massena, N. Y.
Feigenbaum, A. V., General Elec. Co., Schenectady, N. Y.
Field, S. W., Miller & Seddon Co., Inc., Cambridge, Mass.
Goode, J. J., Doelcam, Inc., West Newton, Mass.
Gregg, V. P., General Elec. Co., Schenectady, N. Y.
Haddad, J. A., International Business Machines Corp., Endicott, N. Y.
Hall, C. M., Cutler Hammer, Inc., Boston, Mass.
Hawthorne, R. P., Defender Div., E. I. du Pont de Nemours & Co., Inc., Rochester, N. Y.
Jester, L. T., Jr., General Elec. Co., Boston, Mass.
Kaufmann, W. C., Westcott and Mapes, Arch. & Eng., New Haven, Conn.
Malkowski, H. F., Blackstone Valley Gas & Elec. Co., Pawtucket, R. I.
O'Brien, F. A., Stone & Webster Engg. Corp., Boston, Mass.
Pallace, R. V., General Electric Co., New Haven, Conn.
Peterson, A. W., Chas. T. Main, Inc., Boston, Mass.
Pierce, R. M., General Elec. Co., Schenectady, N. Y.
Rittenhouse, H. J., Schiefer Elec. Co., Inc., Rochester, N. Y.
Ross, S. H., Bendix Aviation Corp., Norwood, Mass.
Schmidt, G. F. (re-election), Cutler-Hammer, Inc., Buffalo, N. Y.
Seasly, E. R., General Elec. Co., Pittsfield, Mass.
Short, W. A., Ens., USNR, 218 Buckingham Ave., Syracuse, N. Y.
Sonntag, J. C., The Hartford Elec. Light Co., Hartford, Conn.
Steele, H. S., General Elec. Co., Schenectady, N. Y.
Straughn, R. Y. (Miss), General Elec. Co., Schenectady, N. Y.
Turrentine, R. E., General Elec. Co., Schenectady, N. Y.
Van Iderstine, W. W., Westcott & Mapes, Inc., New Haven, Conn.
Vershbow, D. R., Modern Die & Machine Co., Boston, Mass.
Wagener, J. A., Crocker-Wheeler Elec. Manufacturing Co., Boston, Mass.
Welsh, J. P., Cornell Aeronautical Lab., Buffalo, N. Y.
Whitney, D. C. (re-election) City of Burlington Elec. Light Dept., Burlington, Vt.
Worcester, R. J., General Elec. Co., Schenectady, N. Y.

2. Middle Eastern

Aldrich, D. F., Westinghouse Elec. Co., Pittsburgh, Pa.
Baker, J., B. F. Goodrich Co., Akron, Ohio
Barnaby, D. R. E., Central Ohio Light & Power Co., Findlay, Ohio
Barter, L. D., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Bechtold, D. J., Northern Pennsylvania Power Co., Towanda, Pa.
Bennett, J. L., Black & Decker Mfg. Co., Towson, Md.
Berghausen, P. E., 444 Rawson Woods Lane, Cincinnati, Ohio
Bickham, A. S., The Master Elec. Co., Dayton, Ohio
Binson, B., Royal Siamese Legation, Washington, D. C.
Bohnert, J. L., Cleveland Elec. Illuminating Co., Cleveland, Ohio
Calderhead, H. J., Bird Electronics Corp., Cleveland, Ohio
Carlson, D. J., Navy Dept., Bureau of Ships, Washington, D. C.
Carney, R. R., General Elec. Company, Philadelphia, Pa.
Chelich, L., Westinghouse Elec. Corp., Pittsburgh, Pa.
Conrad, G. T., Jr., Herbert L. Wilson, Washington, D. C.
Davis, H. E., Boon County Coal Corp., Sharples, W. Va.
Dryden, G. G., Sperry Gyroscope Co., Inc., Baltimore, Md.
Dumont, R. A., Electric Repair Shop, Sparrows Point, Md.
Eaton, E. F., Jr. (ETM 3/C) Navy Dept., Bureau of Personnel, Washington, D. C.
Fetterman, C. D., Philadelphia Elec. Co., Philadelphia, Pa.
Flanagan, J. L., Ensign, USNR, Naval Research Lab., Washington, D. C.
Fox, J. M., Jr., Philadelphia Elec. Co., Philadelphia, Pa.
Freegard, E. M., General Elec. Co., Pittsfield, Mass.
Funk, R. W., Goodyear Tire and Rubber Co., Akron, Ohio
Hales, W. M., Jr., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Hamme, D. E., National Tube Co., McKeesport, Pa.
Handelsman, M., Phila. Signal Corps Inspection Zone, Phila., Pa.
Heintz, C. A., Philadelphia Elec. Co., Philadelphia, Pa.
Heise, L. R., General Elec. Co., Baltimore, Md.
Howenstine, W. L., Potomac Elec. Power Co., Washington, D. C.
Jackewicz, B. S., Elec. Controller & Mfg. Co., Cleveland, Ohio
Jeffrey, R. B., Line Material Company, Zanesville, Ohio
Judd, L. J., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Mack-Forlist, D. M., Bethlehem Steel Co., Baltimore, Md.
Mather, G. H. (re-election), Westinghouse Elec., Corp., Philadelphia, Pa.
McCormick, W. H., American Tel & Tel. Co., Philadelphia, Pa.
McLaughlin, B. E., Public Utilities Div., U. S. Treasury Procurement, Washington, D. C.
Mickle, R. C., Philadelphia Elec. Co., Philadelphia, Pa.
Moll, W. H., Electro-Mechanical Instrument Co., Perkasie, Pa.
Monroe, J. R., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Nagel, C. E., Jr., Westinghouse Elec. Corp., Pittsburgh, Pa.
Palmer, J. B., Jr., Drexel Institute of Technology, Philadelphia, Pa.
Pearce, J. W., The Hoover Co., North Canton, Ohio
Plaisted, R. G., University of Pittsburgh, Pittsburgh, Pa.
Prior, C. A., The Elec. Products Co., Cleveland, Ohio
Ruger, H. D., Bethlehem Steel Co., Sparrows Point, Md.
Schwartz, D. E., USN, Bureau of Ordnance, Washington, D. C.
Scott, A. L., Westinghouse Corp., East Pittsburgh, Pa.
Shawkins, W., Carbide & Carbon Chemicals Corp., S. Charleston, W. Va.
Shuster, D., War Dept., Phila. Sig. C., Inspection Zone, Philadelphia, Pa.
Smith, A. T., British Overseas Airways Corp., Baltimore, Md.
Sparlin, B. J., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Stewart, D. F., Consulting Engineering Co., Inc., Pittsburgh, Pa.
Stude, J. V., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Sucharski, W. T., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Van Arsdell, J. C., Jr., Erie Resistor Corp., Erie, Pa.
Wagner, I. B. (re-election), Lima Locomotive Works, Inc., Lima, Ohio.
Watson, R. E., Leeds & Northrup Co., Philadelphia, Pa.
Willmott, L. J., Firestone Tire & Rubber Co., Akron, Ohio
Zanzie, C. E., United Engineers & Constructors, Phila., Pa.

3. New York City

Bates, S. C., Bell Telephone Labs., New York, N. Y.
Blaiklock, W. J., General Elec. Co., New York, N. Y.
Brooks, G. (Miss), Sperry Gyroscope Company, Great Neck, L. I., N. Y.
Brown, W. E., Raymond M. Wilmotte, Inc., New York, N. Y.
Carfolite, E. D., 571 West 215 St., New York, N. Y.
Cavallaro, S., Lieut. (jg), U.S.N.R., 1326 Morrison Ave., Bronx, N. Y.
Cox, J. L., Duro Test Corp., North Bergen, N. J.
Deering, N. J., Jr., Public Service Elec. & Gas Co., Irvington, N. J.
Feldman, S., 2162 Prospect Ave., Bronx, N. Y.
Friedman, J. G., Heyer Products, Inc., Belleville, N. J.
Granat, E. M., R.C.A., Victor Division, Camden, N. J.
Gropp, G. J. (re-election), National Lead Co., New York, N. Y.
Hailperin, C. B., Vascoloy-Ramet Corp., New York, N. Y.
Lee, J., Century Lighting, Inc., New York, N. Y.
Long, L. A., Radio Corp. of America, Camden, N. J.
MacInnes, D., International General Elec. Co., New York, N. Y.
Mahler, B. B., Federal Telephone & Radio Corp., Newark, N. J.
McCabe, W. R., Lord Elec. Co., Inc., New York, N. Y.
Metzger, C., Hatzel & Buehler, Inc., New York, N. Y.
Ni, C. H., National Resources Comm. of China, Technical Office, New York, N. Y.
Perkowski, S., Western Elec. Co., Inc., New York, N. Y.
Pflugeisen, K., Curtis Elevator Co., Long Island City, N. Y.
Rau, L. E., Lieut., USNR, 121 Birchwood Dr., Belleville, N. J.
Redfern, R. E., U. S. Army Signal Corps Engineering Labs., Ft. Monmouth, N. J.
Sabol, R. W., New York Naval Shipyard, Brooklyn, N. Y.
Sielski, A. T., Bremer Broadcasting Co., Station WAAT, Newark, N. J.
Stega, E. A., Coles Signal Laboratory, Red Bank, N. J.
Stevens, B. C., Jr., Heather Drive, Mahopac, N. Y.
Theobald, G., Public Service Elec. & Gas Co., Newark, N. J.
Tsao, Y., National Resources Comm. of China, New York, N. Y.
Weiss, E., 326 St. Johns Place, Brooklyn, N. Y.
Zellar, G., Western Elec. Co., Inc., New York, N. Y.

4. Southern

Brinson, A. P., Commonwealth & Southern Corp., Birmingham, Ala.
Buford, W. H., Southern Advance Bag and Paper Co., Inc., Hodge, La.
Burnett, B., General Elec. Co., Roanoke, Va.
Coburn, J. E., Alabama Power Co., Birmingham, Ala.
Crescenzi, A. H., Tennessee Eastman Corp., Knoxville, Tenn.
Cullick, I., 557 Forest Avenue, Shreveport, La.
Daniels, A. B., Jr., Schlumberger Well Surveying Corp., Houma, La.
Duffy, J. P., Jr., Sperry Gyroscope Co., Norfolk, Va.
Foster, E. B., Box 549, Sheffield, Ala.
Fox, G. B., Jr., Tennessee Eastman Corp., Oak Ridge, Tenn.
Haller, M. N., U. S. Navy, Bananariver, Fla.
Halsted, B. C., Allis-Chalmers Mfg. Co., Richmond, Va.
Harshbarger, C. K., Sr., Hercules Powder Co., Hopewell, Va.
Horton, J. L., Tenn. Eastman Corp., Oak Ridge, Tenn.
Huguenin, P. B., Florida Power & Light Co., Sarasota, Fla.

Johnson, E. D., Georgia Power Company, Rome, Ga.
Keane, R. J., National Advisory Committee for Aeronautics, Langley Field, Va.
Lacy, J. W., Jr., General Elec. Co., Birmingham, Ala.
La Londe, J. W., USS Leyte, c/o Newport News Shipbuilding & Drydock Co., Newport News, Va.
Lapidus, M., The Engineer Board, Fort Belvoir, Va.
Matthews, W. A., Duke Power Company, Charlotte, N. C.
Morton, A. G., Birmingham Elec. Co., Birmingham, Ala.
Murray, L. B., Tennessee Valley Authority, Chattanooga, Tenn.
Nalley, J. R., Allis-Chalmers, Louisville, Ky.
Neighbors, E. S., Birmingham Elec. Co., Birmingham, Ala.
Pentecost, J. R., Escambia River Elec. Co-operative, Jay, Fla.
Scharres, E. H., Carbide & Carbon Chemicals Corp., Oak Ridge, Tenn.
Shaw, J. D., Va. Elec. & Power Co., Richmond, Va.
Sheap, D. S., Va. Elec. & Power Co., Richmond, Va.
Strock, H. E., E. H. Gilliam & Company, Charlotte, N. C.
Stubblebine, C. A., Georgia Power Co., Atlanta, Ga.
Wagner, R. F., Tennessee Eastman Corp., Oak Ridge, Tenn.
Webb, A. O., University of Tennessee, Martin, Tenn.
Wendel, D. D., Alabama Power Co., Birmingham, Ala.
Woodcock, W. I. (re-election), Alabama Power Co., Birmingham, Ala.

5. Great Lakes

Barlett, T. A., AC Spark Plug Div. of G.M., Flint, Mich.
Blanford, E. C., Clay's Radio Service, Flint, Mich.
Bridges, R. B., Cutler-Hammer, Inc., Milwaukee, Wis.
Bruesch, R. V., Mattison Machine Works, Rockford, Ill.
Copeland, M. J., Commonwealth Edison Co., Chicago, Ill.
Coxhead, S. A., Central Illinois Elec. & Gas Co., Rockford, Ill.
Culhane, J. L., Iowa Power and Light Co., Des Moines, Iowa
Day, C. C. (re-election), Consumers Power Co., Grand Rapids, Mich.
Durbin, H. M., R.C.A. Victor, Indianapolis, Ind.
Ekstrom, I. R., Commonwealth Edison Co., Chicago, Ill.
Evans, F. M., III, U. S. Engineer Office, Rock Island, Ill.
Evans, J. T., Bull Dog Elec. Products Co., Detroit, Mich.
Fink, W. G., Harnischfeger Corp., Milwaukee, Wis.
Flanigan, A. R., Jr., Commonwealth & Southern Corp., Jackson, Mich.
Fowler, R. J., Consumers Power Co., Flint, Mich.
Freeck, A. A., Harnischfeger Corp., Milwaukee, Wis.
Freeman, A., Carnegie Illinois Steel Corp., Chicago, Ill.
Gerber, J. H., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Honeywell, S. W., Sargent & Lundy, Chicago, Ill.
House, H. A., General Elec. Co., Ft. Wayne, Ind.
Imbertson, J. R., Elec. Machinery Mfg. Co., Minneapolis, Minn.
Jacobs, W. E., Consumers Power Co., Jackson, Mich.
Jacobus, C. R. (re-election), General Elec. Co., Duluth, Minn.
Jefferis, T. K., Village of Grosse Pointe Shores, Mich.
Johnson, W. M., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Kaufman, I., RCA Victor, Indianapolis, Ind.
Kirchmayer, L. K., Cutler-Hammer, Inc., Milwaukee, Wis.
Kirk, Harold, Public Service Co. of No. Ill., Chicago, Ill.
McDonald, R. E., Northwest Airlines, Minneapolis, Minn.
Middleton, W. B., Michigan Bell Telephone Co., Detroit, Mich.
Miller, C. E., Purdue University, Lafayette, Ind.
Nemec, G. W., White City Elec. Co., Chicago, Ill.
Noonon, R. F., Michigan State College, East Lansing, Mich.
Pohnan, F. J. (re-election), Commonwealth Edison Co., Chicago, Ill.
Rhodes, E. F., Jr., General Elec. Co., Fort Wayne, Ind.
Risley, M. I., N. W. Bell Telephone Co., Minneapolis, Minn.
Sarvasy, H., 2900 Hazelwood, Detroit, Mich.
Schormmer, O. J., Melborn Development Co., Melrose Park, Ill.
Schwantz, W. G., Commonwealth Edison Co., Chicago, Ill.
Sibley, S. J., City Water, Light & Power, City of Springfield, Ill.
Simmons, C. R., U.S.N.T.C., Great Lakes, Ill.
Sly, R. M., Southern Indiana Gas & Elec. Co., Evansville, Ind.
Smith, L. B., AC Spark Plug Div. of G.M., Flint, Mich.
Thiemann, V., Wisconsin Public Service Corp., Green Bay, Wis.
Vaclavik, F. J. (re-election), The Commonwealth & Southern Corp., Jackson, Mich.
Williamson, R. M., Commonwealth Edison Co., Chicago, Ill.
Woodward, W. V., Northern Indiana Public Service Co., Hammond, Ind.

6. North Central

Beck, H. A. Bureau of Reclamation, Denver, Colo.
Bogard, J. E., Platte Valley Public Power & Irrigation Dist., McCook, Nebr.
Diesman, A. D., Bureau of Reclamation, Denver, Colo.
Fallon, J. L., Bureau of Reclamation, Denver, Colo.
Goodrich, R. D., Jr. (re-election), U. S. Bureau of Reclamation, Denver, Colo.
Staab, M. L., Northwestern Bell Telephone Co., Omaha, Nebr.
Ungemach, C. D., Mountain State Telephone & Telegraph Co., Denver, Colo.
Willumsen, A. S., U. S. Bureau of Reclamation, Denver, Colo.

7. South West

Agnew, G. C., Carter Oil Company, Tulsa, Okla.
Bressler, H., White-Rodgers Elec. Company, St. Louis, Mo.
Brothers, C. E., Harvill-Byrd Electric Co., Little Rock, Ark.
Carter, F., Capt., Field Artillery School, Ft. Sill, Okla.
Cordsen, F. C., Gulf States Utilities Co., Beaumont, Tex.
Deam, A. P., University of Texas, Austin, Tex.
Dickinson, F. C., Army Air Forces, Tinker Field, Okla. City, Okla.
Dumanian, J. A., Manhattan Project, Santa Fe, N. Mex.
Floyd, R. G., Jr., Humble Pipe Line Co., Houston, Tex.
Hartwell, G. E., The Mine & Smelter Supply Co., El Paso, Tex.
Hentchel, T. P., National Geophysical Co., Inc., Dallas, Tex.
Hiestand, D. W., Capt., Signal Corps, U.S.A., 7542 Trenton Ave., University City, Mo.
Hill, S. W., Okla. Gas & Elec. Co., Shawnee, Okla.
Hole, W. G., Southwestern Bell Telephone, Topeka, Kan.
Huller, R. W., Westinghouse Electric Corp., Kansas City, Mo.
Jackson, M. F., Jr., Jackson Elec. Co., El Reno, Okla.
Kaelin, J. A., Kansas City Power & Light Co., Kansas City, Mo.
Keoppel, B. W., Seismograph Service Corp., Tulsa, Okla.
Krachmalnick, F., White-Rodgers Elec. Co., St. Louis, Mo.
Laughlin, J. R., General Elec. Co., Tulsa, Okla.
Lee, H. J., Consolidated Vultee Aircraft Corp., Fort Worth, Tex.
Lynn, L. C., Southwestern Bell Tel. Co., Okla. City, Okla.
Phillips, E. B. (re-election), P. O. Box 483, Stillwater, Okla.
Poolman, J. R., Int. Business Machines Corp., Little Rock, Ark.
Poore, J. N., General Electric Co., Dallas, Tex.
Rich, F. A., Okla. Gas & Elec. Co., Okla. City, Okla.
Rumans, W. W., Burns-McDonnell Consulting Eng. Co., Kansas City, Mo.
Skeeters, O. C., Williamson Sales Co., Dallas, Tex.
Snow, J. H., Dow Chemical Co., Freeport, Tex.
Sorkness, R. E., Base Shops, Randolph Field, Tex.
Stephenson, L. J., U. S. Air Forces, Randolph Field, Tex.
Van Auken, M. E., James R. Kearney Corp., St. Louis, Mo.
Wagner, C. M., R.E.A. Co-operative, Inc., Robstown, Tex.
Wiggins, T., Lower Colorado River Authority, Austin, Tex.
Yang, C. F., TWA Base Engineering Division, Kansas City, Mo.

8. Pacific

Aspinwall, J., Railroad Commission, San Francisco, Calif.
Baldassari, C., The Kerite Co. of New York, San Francisco, Calif.
Brooks, G. R., Allis-Chalmers Mfg. Co., San Francisco, Calif.
de Laneux, H. H., Pacific Gas & Elec. Co., Emeryville, Calif.
Derin, H. H., Fluor Corp. Ltd., Los Angeles, Calif.
Farnham, E. V., Natomas Co., Natoma, Calif.
Garafalo, J. J., Universal Microphone Co., Inglewood, Calif.
Lerner, J., U. S. Naval Base, Terminal Island, Calif.
McComber, L., Pacific Gas & Elec. Co., Sacramento, Calif.
McKnight, R. J., Central Arizona Light & Power Co., Phoenix, Ariz.
Moore, E. J., U. S. Navy Electronics Laboratory, San Diego, Calif.
Ohlson, R. E., General Elec. Co., San Francisco, Calif.
Osen, L. C., 900 Bay St., San Francisco, Calif.
Peterson, W. E., USNR, c/o AIM, AEO, San Francisco, Calif.
Ridgway, R. L., Bethlehem Steel Co., Terminal Island, Calif.
Schiek, W. H., General Elec. Co., San Francisco, Calif.
Scoggins, G. W., Jr., Lieut., N.A.S., Alameda, Calif.
Sears, T. B., U. S. Bureau of Reclamation, Boulder City, Nev.
Van Winkle, W. J., Natomas Co., Natoma, Calif.
Viehe, F. W., 1009 West Madison St., Phoenix, Ariz.
Wilkie, D. F. (re-election), Salt River Valley Water Users Assn., Phoenix, Ariz.

9. North West

Anderson, T. L. (re-election), Provo City Department of Utilities, Provo, Utah
Boatman, A. R., Puget Sound Power & Light Co., Dieringer, Wash.
Clifton, G. M., General Elec. Co., Seattle, Wash.
Conway, H. E., Bonneville Power Administration, Portland, Oreg.
Crosier, R. D., General Elec. Company, Spokane, Wash.
Davies, I. T., Bonneville Power Administration, Portland, Oreg.
Duvall, A. D., Ens., USNR, 805 N. Church St., Salem, Oreg.
Hall, W. P., 3645 Simmers Avenue, Klamath Falls, Oreg.
Heym, D. E., U. S. Engineer Office, Portland, Oreg.
Kessler, A. W., Westinghouse Elec. Corp., Portland, Oreg.
Lienert, J. T., Supervisor of Shipbuilding, USN, Portland, Oreg.
Mageehon, O., Willamette Iron & Steel Corp., Portland, Oreg.
Poland, M. G., Bonneville Power Adm., Portland, Oreg.
Sandberg, J. W., General Elec. X-Ray Corp., Seattle, Wash.
Shanks, C. K., Ensign, USN, 3338 N.W. Franklin Ct., Portland, Oreg.
Wild, W. F., Willamette Iron & Steel Corp., Portland, Oreg.

10. Canada

Cahn, P. R. G., University of Toronto, Toronto, Ont., Can.
Creed, F. C., National Research Council, Ottawa, Ont., Can.
Gordon, L. M., Hydro-Electric Power Comm. of Ontario, Toronto, Ont., Can.
Graham, A., Amalgamated Elec. Corp. Ltd., Toronto, Ont., Can.
Jones, W. E., Ont. Hydro Power Comm., Toronto, Ont., Can.
O'Brien, E. W., Shawinigan Water and Power Company, Trois Rivieres, Que., Can.
Palmer, E. B., Ford Motor Co. of Canada, Ltd., Windsor, Ont., Can.
Pringle, E. W., Hydro-Elec. Power Comm. of Ont., Toronto, Ont., Can.
Purvis, W. J., National Research Council, Ottawa, Ont., Can.
Roper, A. J., Crossman Machinery Co., Vancouver, B. C., Can.
Saffrey, R. H., Fetherstonhauch & Co., Toronto, Ont., Can.
Switzer, W. E., Canadian Pacific Railway, Toronto, Ont., Can.

**Elsewhere**

Agustsson, I., Reykjavik Municipal Electric Light & Power Works, Reykjavik, Iceland
Casares, A., General Elec. S. A., Mexico, D. F., Mex.
Cimet, L., H., The General Supply Co., Mexico City, Mex.
Ghosh, C. S., Calcutta University, Kalighat, Calcutta, India
Gleeson, J., P. O. Engineering Dept., Dublin, Eire
Hawgood, B. V., Westinghouse Elec. International Co., Salisbury, S. Rhodesia
Herrera, A., E., Westinghouse Elec. Intl. Co., Mexico City, Mex.
Hierro A., Ignacio, Public Water Works of City Govt., Tacubaya D. F., Mex.
Hubard, E., Hubard & Bourlon Sucrs., S. A., Mexico, D. F., Mex.
Lee, C., Cerro de Pasco Copper Corp., La Oroya, Peru, S. A.
Moconduy, M. M., Puerto Rico Water Resources Authority, Santurce, P. R.
Perea, E. M., Nicaro Nickel Co., Nicaro, Oriente, Cuba
Lowe, R. D., Ministry of Munitions, Sydney, N. S. W., Australia
sante O., P., Union Mercantil, S. A., Monterrey, N. L., Mex.
ully, L. S., Jr., USN, 17th Naval District, Kodiak, Alaska
Punter, H., Messrs. Falk Stadelmann & Co. Ltd., Birmingham, England
Rodriguez, M. A., National Institute of Cardiology, Mexico City, Mex.
Romero M., J., Victoria #37-D, Mexico City, Mex.
Rowney, H. J., Army Headquarters, Wellington, New Zealand
Sampson M., E., General Electric S. A., Mexico City, Mex.
Sathar, S. A., Telegraphs (Govt. of India), Bangalore, India
Sharma, B. R., Punjab P. W. D., Electricity Branch, Lahore, India
Spindola L., L. R., Westinghouse Elec. Intl. Co., Mexico City, Mex.
Subramaniam, R., M. E. S., Office of Garrison Engineer, Hospital Town, Bangalore, India
Voyles, J. E., All America Cables & Radio, Inc., Lima, Peru, S. A.
Wilson, K. A., State Hydro-Electric Dept., Wellington, New Zealand

Total to grade of Associate

United States and Canada, 302
Elsewhere, 26

# OF CURRENT INTEREST

## Co-operation Ahead for ASA and Commerce Department

A partial reorganization of the Department of Commerce and ASA facilities for preparation of standards which was set in motion by a report of the Policy Committee on Standards appointed by Secretary of Commerce Henry Wallace in 1945 places Government approval on voluntary action by industrial groups as the most desirable basis for determining industrial and consumer standards.

In reports made to Mr. Wallace in June and December 1945, the chairman of the policy committee, Charles E. Wilson, president of the General Electric Company, recommended that standards submitted to the Department of Commerce for development or publication by consumer or industrial groups be referred to the American Standards Association by either the sponsoring group or the Department for approval and publication as American Standards. If the sponsoring group desires publication of the standard before its acceptance as an American Standard, the later Wilson report recommends that this be done by the interested group and not under the name of the Department of Commerce. In this connection the report points out that publication by the Commerce Department often leads to acceptance of the standards as ones developed and approved or enforced by the Government, whereas they are only records of voluntary trade group action. The report recognizes the need for a revision of ASA facilities to encompass the recommended scope of activity.

It recommends the transfer of the divisions of Simplified Trade Practices and Commercial Standards from the National Bureau of Standards.

In accordance with Mr. Wilson's proposals, Mr. Wallace has agreed that the maximum support be given to ASA activity to strengthen its position as the fountainhead of standardization work in the country. In a letter to Mr. Wilson he proposes that "to the extent that the American Standards Association reorganizes its procedures in accordance with the recommendation of your Committee so that it can perform trade standard services to the satisfaction of all the groups with an interest in standards, the Department is prepared to encourage the use of the facilities of the American Standards Association for the initiation, development, and publication of standards." Mr. Wallace further states "the Department would be prepared as a matter of policy to suggest when the Association's facilities are adequate that standards be submitted to the ASA for publication as American Standards." At the same time he would leave freedom of choice in the matter to the sponsoring business group.

As evidence of his desire to co-operate with the ASA, Mr. Wallace suggests "that a joint conference committee of the ASA and the Department be set up for this purpose. I believe that this conference committee should cover the entire field of standards—the scientific, technical, and testing aspects as well as the economic marketing and trade aspects of the problem—and that the Department's representatives on the committee therefore should include scientists of the National Bureau of Standards as well as officials of the Office of Domestic Commerce, Office of the Solicitor, and the Office of Program Planning."

As Mr. Wilson recommended, the divisions of Simplified Trade Practices and Commercial Standards have been transferred from the National Bureau of Standards to the new Office of Domestic Commerce. Such voluntary standards as these divisions will be requested to publish will be printed by the Department of Commerce and not by the National Bureau of Standards, which should lead to less confusion about the status of such standards. Credit for any research work it may perform will be given to the Bureau. The two divisions will continue to sponsor and perform basic research in the economic and marketing fields for ASA and other groups formulating standards and will propose standards to the ASA.

Mr. Wallace adds that he does not believe the Department can ignore industry and economic groups that request its assistance which is a statutory responsibility. For this reason some Departmental publication activity will be continued.

He is in accord with the Wilson report's definition of the Bureau of Standards functions as those of basic research, furnishing of facts, measurements, and technical assistance in the development of adequate testing methods, expresses approval of the expansion and improvement of voluntary industrial standardization activity, and sees the Department's role as one of encouraging and stimulating such activity.

In announcing ASA's full co-operation with Mr. Wallace's views, Henry B. Bryans, ASA president, enumerated the steps already taken in strengthening the Association along the lines of the Policy Committee's recommendations.

Through a change in its constitution, the ASA has broadened the scope of its work, so that it may deal with any standards or standardization projects deserving national recognition, whether in the field of engineering, consumer goods, or in other fields.

The representative character of the ASA board of directors is being rounded out by adding a consumer leader, a retailer, and a publisher of a national magazine. The principal consumer and other groups concerned are represented on the main ASA committee on consumer standards. Methods of work have been streamlined.

The representative character of the ASA has been broadened by membership of thirteen additional national organizations in the last year bringing the total to 94 national organizations.

Plans are already under way to expand the ASA financial structure, as well as to broaden the incidence of support and participation in the ASA.

An executive committee headed by Howard S. Coonley has been entrusted with the task of making provision for meeting the greatly increased responsibilities placed upon the Association by the Wilson report. Mr. Coonley, past president of the ASA and the National Association of Manufacturers, has just retired from the position of chairman of the board of the Walworth Company and plans to devote most of his time to directing the ASA development program. During World War II he headed the conservation, standardization, simplification, and specification work of the War Production Board and was advisor to the Chinese Government in setting up its War Production Board.

A start on standards for consumer goods has been made. These include such subjects as: safety shoes for men and women, women's industrial clothing, and a comprehensive set of specifications for gas burning appliances.

Among the subjects now under development are: specifications for electrical appliances, methods of test and terms for describing color fastness, and definition of textile terms used in the retail trade.

A Standard designed for the protection of the public in advertisements containing statements of approval by laboratories and similar means, such as "Approved by . . .," "Guaranteed by . . .," "Certified by . . .," is nearly ready for formal approval as an American Standard. The greater part of the work of the ASA, however, remains in the industrial field.

New methods of carefully controlled service tests, coupled with some of the newer specialized methods of market research, are being used extensively by some manufacturers and distributors. These, together with the research activities which Secretary Wallace is organizing in the Department of Commerce, and similar activities on the part of business groups, promise to make available for work on consumer standards constructive facilities that hitherto have been lacking in many fields.

# Edison Association Endorses McMahon Bill

A special committee on appraisal of atomic energy, established by the Association of Edison Illuminating Companies to explore and appraise both the favorable possibilities and the limitations of atomic energy in the field of electric power supply, has endorsed the McMahon Bill (S1717) through its chairman John C. Parker (F '12) who recently testified before the United States Senate Committee on Atomic Energy on behalf of the association. The McMahon Bill would place control of atomic energy in a completely civilian agency, with a military section below the policy making level.

According to Doctor Parker, the committee which he represents is seeking to explore the probabilities of better service to the community and will avoid inquiry into the specific technique of the processing of fissionable materials or their utilization in fields other than that of heavy power generation. In this connection the committee is asking the assistance and advice of departments of the government as well as of scientists and engineers, and the design and other technical talent of the manufacturers.

"Most of the investment and much of the operating cost of present systems lie outside the generating plants—for example, in the distributing systems and in the multifarious services to the customers," said Doctor Parker in speaking of the economy of atomic energy. "There is no present indication that atomic energy will relieve that major element in cost. If this is correct then the primary advantage to the national economy will be in the service of that part of the utility load in which fuel costs play the relatively biggest parts, namely, industrial and heavy traction load, and the economies here probably will not be much greater than the difference in fuel cost."

Doctor Parker went on to clear up two popular misconceptions about atomic energy, one as to the amount of energy that would become available through atomic processes and the other that the public utilities might be unduly apprehensive of the obsolescence of their plant and property by a new technique.

"Never at any time," Doctor Parker stated, "has the United States suffered from a deficiency in the amount of power available. All that is necessary to expand the availability of electric power vastly is the construction of plants, transmission and distribution systems. Expansion of electric energy as a result of the development of atomic energy will occur, if at all, only after an extended period of time and as it proves economical."

In reference to the second "misconception" Doctor Parker explained that old boiler plant and combustion equipment may be removed, giving place to the newer type of boiler, with or without its own high-pressure high-temperature turbine. Thus steam would be produced for use in the present turbogenerators either directly or through the intervention of an atomic topping turbine.

"When it becomes reasonably certain that sound economic advantage will result from atomic sources," he continued, "it is fully expected that the rate of increase of central station energy utilization will make possible the introduction of atomic "toppers" for base load purposes, that is, for energy production round the clock so that the fullest operating advantage may be had from the replacement of the current conventional practices. It seems equally probable that the cost of new equipment will not be warranted or if so only in lesser degree by that part of the load which is of short duration. Thus, much of the unconverted present conventional equipment will represent the most realistically economical method of meeting the requirements of the community and therefore will have an undisturbed usefulness through its natural physical life."

However he added that "were the economic attractions of atomic energy in the course of time to prove so great that even peak load and reserve equipment would be forced into the scrap heap that fact itself would say that there were advantages sufficient to warrant the processes of supersession."

Doctor Parker declared that the public utility industry of the United States believes that atomic materials should be available for industrial use without differentiation as to the type of utility to which it is made available and with the single collateral requirement that any resultant net economies be passed on to the consumers under the supervision of regulatory authorities on the local level.

"As an association," he said, "we completely endorse the theory that the processing of such materials for use must be under the control of some such commission as is proposed in the Bill under discussion. The possibilities of misuse under any other scheme of production are too ghastly to be contemplated. As a collateral of such control, licenses for use seem quite inevitable. The greatest measure of effectiveness is, in our judgment, in the denial of release of materials to those who do not comply with the prescriptions."

Doctor Parker concluded, "The association does not offer comment at the present time on minor details of the McMahon Bill which it assumes will be modified somewhat, but regards the general structure of the Bill as most favorable to the orderly development of peaceful uses of a new technique which can be of great service to mankind."

The Association of Edison Illuminating Companies, sponsor of the special committee, is made up of member companies and operates primarily as a conference of executives with the assistance of the technical and commercial personnel of the member companies for the purpose of interchange of ideas and information. In addition to Doctor Parker, Consolidated Edison Company of New York, Inc., New York, N. Y., and AIEE Past-President, committee personnel includes Alex D. Bailey, Commonwealth Edison Company of Chicago, Chicago, Ill.; Kilshaw M. Irwin, Philadelphia Electric Company, Philadelphia, Pa.; James W. Parker, The Detroit Edison Company, Detroit, Mich.; and Philip Sporn (F '30) American Gas and Electric Service Corporation, New York, N. Y. Ward F. Davidson (F '26) Consolidated Edison Company of New York, Inc., is committee secretary.

**AAF Studies Radar Navigation Systems.** As the result of a recent five-day conference between Army Air Forces officers and leading manufacturers of radar equipment to determine the best radar system of air navigation for all-weather flying, the AAF will set up a technical committee to study all systems presented. Demonstrations will be held at Wright Field, Dayton, Ohio.

## FTC Supports Patent Law Revision

Endorsement of seven proposals for patent legislation by the Federal Trade Commission in its annual report to Congress constitutes the opening gun in a new campaign to obtain drastic overhauling of the patent laws, according to a recent report of the National Patent Council.

In emphasizing the importance of FTC approval for the proposed changes, the Patent Council points out that the FTC always has obtained its appropriations from Congress without question. It works and co-operates closely with Congress, and two of its five members are former members of the House—William A. Ayers of Kansas and Ewin Davis of Tennessee. Key planner of the Commission's patent program is Willis J. Ballinger, economic adviser, formerly a member of the Temporary National Economic Committee which originally drafted the FTC's seven proposals.

The FTC concludes from the TNEC report that "the privilege accorded by the patent monopoly has been shamefully abused . . . that the privilege given has not been used as was intended by the framers of the Constitution and by the Congress, 'to promote the progress of science and the useful arts.' It has been used as a device to control whole industries, to suppress competition, to restrict output, to enhance prices, to suppress inventions, and to discourage inventiveness," FTC contends.

In submitting its recommendations, the FTC clarifies its position with the statement "that if the pattern of control which has been achieved through the patent monopoly continues in spite of the changes we suggest, a complete re-examination of our patent laws should be made with a view to

determining whether, under present-day conditions, they are calculated to achieve their avowed purposes."

"Indicated changes," the Committee report continues, "in the patent laws divide naturally into two general classes—procedural and substantive. In its preliminary report to the Congress, dated July 17, 1939, the Committee made certain recommendations with respect to the patent laws. Some of the procedural changes recommended have since become law. Subsequent examination of the problems has confirmed our belief that substantial changes are needed, including some in addition to those already recommended."

The seven proposals as sent to Congress follow:

"(*a*). *Licensing of Patents.* In order to eliminate the use of patents in ways inimical to the public policy inherent in the patent laws, as well as that of the antitrust laws, we recommend that the Congress enact legislation which will require that any future patent is to be available for use by anyone who may desire its use and who is willing to pay a fair price for the privilege. Machinery, either judicial or administrative, should be set up to determine whether the royalty demanded by the patentee may fairly be said to represent reasonable compensation or is intended to set a prohibitive price for such use.

"This proposal is intended to prevent the suppression of patents as well as to provide for their availability for use in an equitable manner in any industry where they are a major factor.

"(*b*). *Unrestricted Licenses.* We recommend that the owner of any patent be required to grant only unrestricted licenses, and that he not be permitted to impose restrictions upon the buyer in sales of patented articles. There should be a further prohibition against any other restriction which would tend substantially to lessen competition or to create a monopoly, unless such restriction is necessary to promote the progress of science and the useful arts.

"(*c*). *Recording of Transfers and Agreements.* We recommend that any sale, license, assignment, or other disposition of any patent be evidence by an instrument in writing and that the same be required of any condition, agreement, or understanding relating to any sale or disposition of any such patent, and that in any such case a copy of such written instrument be filed with the Federal Trade Commission within 30 days after execution. There should, of course, be a substantial monetary penalty for failure to file as required.

"(*d*). *Limitation on Suits for Infringement.* In order to prevent the use of litigation as a weapon of business aggression rather than as an instrument for adjudicating honest disputes, we recommend legislation which will provide that no action based upon a charge of infringement of any patent, whether for damages, for an injunction, or for any other relief shall be permitted against any licensee under a patent or against any purchaser or licensee of any article unless the plaintiff has previously secured a judgment against the grantor of the license or the manufacturer of the article for infringement in connection with the granting of such license or the sale of such article.

"(*e*). *Forfeiture of Patent for Violation.* If any person who owns any interest in or right under a patent violates any of the prohibitions described in paragraphs (*a*) and (*b*) above, his interest therein should be forfeited, such forfeiture to be brought about in a civil action against such person by the United States. Any patent or interest therein so forfeited should become a part of the public domain.

"(*f*). *Single Court of Patent Appeals.* In order to improve the existing mechanism for the issuance of patents and the determination of disputes relating thereto, we recommend the creation of a single Court of Patent Appeals with jurisdiction coextensive within the United States and its territories. Such a court would replace the present 11 different and independent jurisdictions and should do much to assure uniform treatment of patents and to reduce the time and cost of patent litigation.

"(*g*). *Limitation on Period of Patent Monopoly.* The life of a patent should be so limited that it will expire not more than 20 years from the date of the filing of the application, thus obviating the possibility of prolonging the patent monopoly by keeping an application pending in the Patent Office. This would mean that if an application were kept pending in the Patent Office for more than three years, the 17-year term of the patent granted would be to that extent decreased."

# New Research Bills Replace Kilgore and Magnuson Bills

A new bill, S1850, proposing the establishment of a National Science Foundation has been introduced into the Senate by Senators Kilgore, Magnuson, Johnson, Pepper, Fulbright, Saltonstall, Thomas, and Ferguson. S1850 is a revised composite of two bills introduced last July by Senators Kilgore and Magnuson, respectively, and incorporates elements of each. Ostensibly a compromise reconciling the essential differences and weaknesses of its predecessors as brought out in voluminous testimony, S1850 actually establishes precepts and procedures whereby government would have complete control not only of research, but of developments growing out of research. The Bill thus seems to renounce the recommendations made in previous hearings by a majority of scientists.

On the premise that a central scientific agency is necessary "to provide support for scientific research and development, to enable young men and women of ability to receive scientific training, to promote the conservation and use of the natural resources of the Nation, to correlate the scientific research and development programs of the several Government agencies, to achieve a full dissemination of scientific and technical information to the public, and to foster the interchange of scientific and technical information in this country and abroad," the bill sets up the Foundation, which is not to be an operating agency but rather serve to support research in existing organizations.

Administration of the proposed Foundation will be in the hands of a full-time salaried administrator appointed by the President and a National Science Board composed of nine members appointed by the President and the chairmen of the scientific committees heading the Divisions of the Foundation. The appointed members of the Board will serve on a part-time basis and will be so compensated. Their powers will be consultative and advisory.

Divisions of the Foundation enumerated in the bill are: Mathematical and Physical Sciences, Biological Sciences, Social Sciences, Health and Medical Sciences, National Defense, Engineering and Technology, Scientific Personnel and Education, and Publication and Information, and latitude is allowed for the formation of such additional division as may seem desirable. The provision is made that half of the members of the scientific committee for the Division of National Defense shall be civilians and half shall be appointees of the War and Navy Departments. Members of the Board and the divisional scientific committees will serve for three years with one third retiring each year.

The administrator is empowered to enter into contracts for financing or otherwise supporting research and development activities of other Government agencies or other organizations, to appoint a Deputy Administrator, to appoint the Directors o the Divisions, and the members of the divisional scientific committees. He must make an annual report to Congress and the President on the activities of the Foundation, including in it any dissenting opinions that may exist among the members of the Board or the divisional committees. He must maintain a register of scientific and technical personnel and in other ways provide a clearing house for information concerning scientific and technical personnel in the United States and its possessions. He may make contracts through the Department of State to co-operate in appropriate international research or developmental activities. He is authorized to award scholarships and fellowships to persons for scientific study or scientific work in any field of science.

Funds appropriated to the Foundation will remain expendable for four years following the appropriation. Of the funds appropriated to the Foundation for research and developmental activities, exclusive of those concerned with national defense, 65 per cent are circumscribed by the bill. Of this 15 per cent must be applied to projects pertaining to national defense and to health and medical sciences; 25 per cent must be apportioned among the states—two fifths in equal shares and the remainder in proportion to their population. The remaining 25 per cent must be expended in the facilities of nonprofit organizations.

Patents which accrue to the Government as a result of Foundation sponsored research will be made available to the public on a nonexclusive royalty-free basis. However, if a contract so stipulates, patent rights may be retained by private organizations, but the Government reserves the right of use on a nonexclusive royalty-free basis. Though in general the Administrator is obligated to publicize widely the results of Government supported research, this duty may become inoperative if the national security demands it.

The Office of Scientific Research and Development and the National Roster of Scientific and Specialized Personnel would be transferred to the Foundation by the bill.

The apparent purpose of S1850 is twofold. On the one hand, it undertakes to

carry over into peacetime the OSRD type of organization to assist and supplement the research programs of the armed services. On the other hand and in line with the Bush report, it, like the separate Kilgore and Magnuson bills which it supersedes, undertakes to set up a mechanism whereby Congress can appropriate public funds to assist institutions of higher learning in the development of scholarship and fundamental research. The merits of the bill must be judged partly upon the apparent effectiveness of the organization it sets up to accomplish these two purposes. But it must also be judged upon how many extraneous powers and privileges it grants this organization and the federal executive above it. Were it enacted into law, it would establish a very broad enabling act and centralize enormous power over both science and technology in the executive department of the government. The portents of the bill are so serious that they deserve wide discussion. The extended record of hearings make this especially pertinent, for the bill will be found widely at variance with the recommendations made by a majority of scientists in the hearings.

BILL S1777

An alternate proposal for a National Science Foundation composed of 50 members chosen from distinguished men and women in the fields falling within the orbit of the National Academy of Sciences or represented by similar national organizations has been submitted to the Senate in bill S1777, by Senators Willis, Hawkes, Kickenlooper, Wiley, Stanfill, Hart, Smith, and Young.

The President would select all 50 members from nominees presented by the National Academy of Sciences and the national scientific organizations in fields not within the province of the Academy. The Foundation would establish its own rules of organization and fill vacancies among its membership as they arose. The Foundation would not be empowered to make contracts but would have the function of advising Congress of activities worthy of Government support. It would submit an annual report to Congress and foster the maximum dissemination of technical information and scientific discoveries, as well as cooperate with the Secretary of State in furthering international scientific activity.

The members would serve without salary, and the bill proposes to appropriate $100,000 to cover the expenses of organization and the making of its initial report and recommendations. S1777 would preserve the independence of science, in the American tradition, and yet would make financial aid possible.

## British Research Bill Now Before Parliament

The creation of an industrial research association for each industry is proposed by the Industrial Research Bill now under consideration in the British House of Lords.

If the bill becomes law most industrial establishments will be required to join associations which will be financed by a tax levy on the proprietors of industry not exceeding one per cent of each contributor's annual revenue. However a method of "contracting out" of such associations is provided for those who would not derive benefit from it; provision also is made for proprietors who wish to appeal for exemption from the terms of the law.

The bill enables the majority interest in any industry to put before the Board of Trade a scheme for operating an association. Once the Board approves the scheme, a poll will be taken of the proprietors in that industry, and, if those in favor represent 75 per cent of the annual revenue in the industry, a research association is formed.

## ASA Standardizes Commercial and Household Lamps

A committee which will assure interchangeability of the various types of household and commercial lamps, recently was organized by the American Standards Association.

Present at the first meeting were representatives of user groups, lamp manufacturers, technical and trade associations, and departments of the Federal government. Preston S. Millar (M '13) president of the Electrical Testing Laboratories, New York, N. Y., was appointed chairman of the new committee, and J. W. McNair (A '25) of the ASA, secretary.

As outlined at the first meeting, the committee's work will be concerned with standards of interchangeability of incandescent and gaseous conduction lamps and of the electrical characteristics of operating auxiliaries and with methods of test for such lamps and auxiliaries. It was agreed tentatively that the preliminary work would be carried out through three subcommittees: one on incandescent lamps; one on fluorescent lamps, mercury vapor, and the like; and a third covering methods of testing lamps and auxiliaries. Special attention will be given to the newer types of fluorescent and mercury lamps now coming into wide use.

# INDUSTRY . . . . .

## Royalty-Free License Offered to Make Bell Equipment

A royalty-free license under Bell System patents to make equipment developed by the Bell Telephone Laboratories for sending telephone conversations over rural electric power lines is being offered to manufacturers of telephone equipment in the United States, the American Telephone and Telegraph Company recently announced.

Known as the rural power line carrier system, the development permits the simultaneous transmission of both telephone conversations and electric power over the same line in rural areas where telephone wires are lacking. The company states that the power line carrier is one of several methods the Bell System is perfecting for use in attaining its objective of extending telephone service to a million additional farm families within the next few years. Carrier development interrupted by the war now has been resumed. Public tests are being conducted near Jonesboro, Ark., with the co-operation of Rural Electrification Administration engineers and jointly with the Alabama Power Company at Selma.

As soon as developments and field trials now under way have progressed sufficiently, other apparatus will be manufactured for the Bell companies by the Western Electric Company and will be available for sale through the Graybar Electric Company.

In a letter to W. C. Henry, president of the United States Independent Telephone Association, announcing this, Keith S. McHugh, vice-president of AT & T, also stated that "at the same time we shall be prepared to extend to manufacturers in this country a royalty-free license to make such power line carrier apparatus in so far as Bell System patents are involved and to sell it for use in the United States for the purpose of extending telephone service directly from a central office of a telephone company to the premises of its rural customers, including service line customers."

Although they expect power line carrier to serve a real purpose in extension of rural service, telephone engineers point out that most farm families will be served by conventional telephone wires. More than 80 per cent of rural residents live within reach of existing telephone pole lines.

## RMA Welcomes Amateurs Into Its Fold

With nearly 70,000 licensed radio amateurs in the United States at present and with their numbers expected to increase to between 250,000 and 500,000 in a few years, the Radio Manufacturers Association has given recognition to "ham" activity by forming a new Amateur Radio Activities section with William J. Halligan as chairman.

Purpose of the new section will be to act as a clearing house of information concerning new products needed by amateurs, to establish standards of good engineering practices relative to amateur radio equipment, and to work closely with the American Radio Relay League in the support of amateur radio in legislative and regulatory matters. Subcommittees have been organized to deal with equipment, equipment parts, frequency and power regulation, and promotion and development of amateur radio in foreign lands. W. A. Ready (M '28) president of the National Company, Malden, Mass., is a subcommittee head.

The last-named subcommittee has the

task of encouraging greater recognition of amateur operation among foreign governments, some of which have taken active measures against amateurs. Pointing out that amateur frequencies are established by international agreement, Mr. Halligan ascribed most of the losses which amateurs have sustained to the antipathetic attitude of other governments. The RMA hopes to persuade foreign manufacturing associations to co-operate with their national amateur organizations. Mr. Halligan declared that amateur radio furnished a backlog of skilled personnel to the radio industry and listed as the outgrowth of amateur work the discovery of the practical value of short waves, the introduction of low-loss coils, the neutrodyne, the single control superheterodyne, the single signal receiver with crystal filter, the noise limiter, and the first application of 100 per cent modulation.

## Recent Progress in Silicones Reported by Two Companies

A special program for the development of laminates from silicone resin and fiber-glass fabric base for use in applications where resistance to high temperature is necessary is in progress at the Formica Insulation Company, Cincinnati, Ohio, under the sponsorship of the Navy Department Bureau of Ships.

An essentially satisfactory laminated sheet material has been produced, the company discloses, and is in process of being tested. It is expected to provide electrical insulation material having properties of extremely high resistance to temperature and able to withstand heat far in excess of materials used during the war.

A silicone glass laminate developed by the General Electric Company, Schenectady, N. Y., also has reached the testing stage. This laminate has survived a week-long test at 250 degrees which surpasses the resistance of any similar product. According to the company's announcement, ordinary solder will melt before this new material, constructed of layers of glass cloth treated with a silicone resin and subjected to heat and pressure, will break down. The weight of the material is about the same as magnesium and the company anticipates using it in such standard equipment as motors, circuit breakers, induction heaters, and high frequency oscillators. Other possible uses are as handles for arc welding electrodes and for indestructible insulating parts of devices subject to fire hazards.

## International Lighting Exposition in Chicago

Manufacturers of lamp and lighting equipment and of products related to lighting will display the most recent developments in that field at the International Lighting Exposition to be held April 25–30, 1946, in the Stevens Hotel, Chicago, Ill.

A series of conferences will be held for architects, electrical contractors, wholesalers, industrial executives, illumination engineers, school authorities, public officials, industrial, and business executives. Some of the problems discussed will be: how light can be used to increase sales; how the industrial executive can increase production, reduce accidents, and conserve eyesight; how improved lighting in schools betters educational results; and how the contractor or utility representative can introduce newest developments to customers. An industry round table discussion will be featured on the subject "What New Methods and Materials for Technical and Sales Training Are or Will Be Available."

Industrial exhibits presenting the latest trends in lighting for industry, business, stores, farms, play areas, schools, airports, and streets have been arranged. In addition an educational exhibit is being sponsored by the Illuminating Engineering Society.

Among the new lighting developments to be introduced to the public are: completely redesigned fluorescent lighting units of porcelain enamel, steel, and plastics; new types of units including cove and built-in lighting; prismatic glass light control equipment; explosionproof aviation, street, subway, and viaduct lighting equipment; sports, service station, and other types of flood lighting; germicidal lamps; and new desk lamps.

## Illinois Institute Laboratory Initiates Service for Industry

The facilities of the laboratory for precision measurement of electrical and magnetic quantities, which was established at the Illinois Institute of Technology in 1945 (*EE, Apr '45, p 169*) through a gift of the Ohmite Manufacturing Company, now are available to sponsoring organizations, according to an announcement by Doctor J. E. Hobson (M '41) director of the Institute's Armour Research Foundation.

Designed to provide services to industries within the Chicago area, the laboratory also will be used for graduate study and in electrical standardizing work for the various departments of the school. Although some equipment for the precision measurement work is not yet available, the laboratory is equipped for the following activities: calibration of standard cells, shunts, standard resistances, capacitors, inductors, d-c and a-c ammeters, voltmeters, wattmeters, and watt-hour meters; conductivity measurements and insulation resistance measurements; determination of the properties of magnetic materials; measurements of power factor and dielectric constant of liquid dielectrics; oscillographic work; and radio and radio frequency measurements, including frequency checks and field strength determinations up to 20 megacycles, determination of $Q$ and antenna impedance.

According to L. W. Matsch (M '41), codirector of the undertaking, the activities in the Ohmite Laboratory are expected to include high-voltage measurements up to 100,000 volts by the middle of 1946. The scope of the audio and radio frequency work also will be increased.

## Baltimore–Norfolk Boats Install Radar Equipment

First major marine installation of radar equipment as a navigational aid on commercial passenger-carrying vessels has been made by the Westinghouse Electric Corporation on the Old Bay Line's night boats making the 185-mile run between Baltimore and Norfolk.

The type of installation made for the operational test runs provides a continuous picture of ship traffic and shore line conditions for a range of from 100 yards to 32 miles of the ship at all times. Water surfaces will be dark on the 7-inch viewing area of the cathode ray tube indicator, while any obstruction will show as a bright fluorescent pattern. Ships will appear graphically and shore lines as on a map. For navigation in narrow channels, approaching piers, or near other craft, the viewing area gives greater detail, duplicating a circle only four miles in diameter with the ship in the center.

The antenna is mounted under a large mushroom-shaped plastic dome atop a $5^1/_2$-foot pedestal on the wheelhouse roof with the modulator, preamplifier, and other radio frequency components in the weatherproof base of the pedestal. The receiver-indicator console, a cabinet 2 feet square and 48 inches high, is located on the bridge. Power for operation of the equipment is provided through a below-decks rotary converter from the ship's main d-c power supply.

## Flight Tests Verify Stratovision Operation

Tests of "Stratovision," a proposed system of nation-wide television and frequency-modulation broadcasting from airplanes operating in the stratosphere (*EE, Sept '45, p 346*), show that usable signals can be transmitted over a distance of 240 airline miles from an altitude of 25,000 feet using only 250 watts of power, according to a recent announcement of the Westinghouse Electric Corporation, codeveloper of the system with The Glenn L. Martin Company.

Transmission characteristics of both television and frequency modulation were studied during the test flights. Television work centered around the problem of "ghosting"—out-of-register viewing which occurs when a receiver picks up a signal by two different wave paths. Frequency modulation data were obtained on transmission in the new band above 100 megacycles by a constant recording of field strength of a carrier wave, both modulated and unmodulated.

The tests, which are being checked by Federal Communications Commission

monitoring stations, are made with a refitted twin-engine medium bomber and a ground station located at the Baltimore, Md., plant of the Westinghouse corporation.

## RCA Inspection Device Detects Metal Particles

An industrial inspection device with a high degree of flexibility of application which will detect metal particles of any kind present in nonmetallic industrial materials recently was displayed by the RCA Victor Division of the Radio Corporation of America at the 20th Chemical Exposition in New York.

The versatile completely self-contained unit is 43 inches long by 15 inches wide with an over-all height of 20 inches plus the height of the inspection aperture, which varies from 4 to 12 inches. In operation, materials passing through the aperture by means of a conveyer belt or a chute, are screened by a high-frequency electromagnetic field, generated by coils embedded in plastic panels above and below the aperture. An electronic oscillator supplies high-frequency power to the coils, and the reaction set up by metal is detected and amplified by an electron tube amplifier. This amplified reaction can be used to light a warning lamp, ring a bell, stop a continuous process, mark the contaminated object, or deflect it into a special channel for rejects.

Unlike magnetic detectors, the device will expose any kind of metal alloy, including iron, copper, brass, lead, aluminum, stainless steel, and others. It can be adjusted so that it will detect the required size of particle for each installation. The operator need check the adjustment of only one simple control approximately once a day.

**Chicago Exposition Postponed.** Because of the uncertainty about production and deliveries among the nation's manufacturers, the Products of Tomorrow Exposition scheduled to open April 27 in Chicago has been postponed indefinitely, according to Marcus W. Hinson, general manager of the exposition. Manufacturers who intended to display their postwar products now consider it inadvisable to participate in public exhibits until they are more certain of their future capacity for delivery, Mr. Hinson said. Mr. Hinson revealed that industrialists in India, Britain, Russia, Holland, China, and South America have indicated their intention to take part in the exposition which may be held in the fall of 1946 or early in 1947.

## Westinghouse Again Awards Fellowships

Resumption of its fellowships for young scientists to work on pure scientific research of their own choosing has been announced by the Westinghouse Electric Corporation.

Appointment of three young men for a year's work in the company's research laboratories will be made in May, and work on the various projects will be started by October 1. Applications must be received at the Westinghouse laboratories by April 15. Under the fellowship plan, young scientists having training equivalent to that represented by a doctor's degree from a recognized university are selected for one year's work. They may be reappointed for a second year if mutually desirable. The fellowship has a value of $3,000 a year.

The board of review making the appointments is composed of Doctor L. W. Chubb (F '21), director of the Westinghouse laboratories, Doctors C. R. Hanna (M '30), J. A. Hutcheson (M '44), and Joseph Slepian (F '27), all associate directors, and the manager of the department in which each applicant's project will be carried out.

## Jewett Fellowships Awarded

Award of five Frank B. Jewett fellowships for postdoctorate research in the physical sciences has been announced by the American Telephone and Telegraph Company which founded the grants in 1944 upon Mr. Jewett's retirement as vice-president of the company.

The recipients, three of whom are chemists and two physicists, are Doctor Martin G. Ettlinger of Harvard University and Austin, Tex.; Doctor Edward W. Fager of Manhattan Project and New York; Doctor Bernard Goodman of the University of Pennsylvania and Philadelphia; Doctor Shuichi Kusaka of Northampton, Mass.; and Doctor Robert L. Scott of Manhattan Project and Santa Ana, Calif. All have been engaged in war research with the exception of Doctor Kusaka, a native of Osaka, Japan, who was teaching at Smith College until he resigned to enlist in the Army and obtain United States citizenship.

The awards carry an annual stipend of $3,000 to the holder and $1,500 to the institution at which the recipient elects to do research. Principal criteria used in selecting the recipients are: demonstrated research ability, the fundamental importance of the problem to be attacked, and the likelihood of his growth as a scientist.

**Anniversary of Telephone.** The 70th anniversary of the telephone, first patented by Alexander Graham Bell on March 7, 1876, was observed this year. It was not until May 1877 that the first telephones were put into use commercially but 68 years later, by the end of 1945, there were 22,445,500 Bell System telephones in service, plus more than 5,400,000 operated by 6,000 independent companies. Future plans for the telephone include nation-wide dialing by long-distance operators, devices for taking a message if there is no one to answer the telephone, and extension of the use of two-way voice communication by radiotelephone between motor vehicles.

**Chileans Ask Manufacturers' Literature.** The Universidad Tècnica Federico Santa Maria of Valparaiso, Chile, is interested in receiving catalogs, pamphlets, and prospectuses of the leading manufacturers in the United States handling machinery and technical equipment, according to the United States Consul in Valparaiso. The university has material from European manufacturers but little or none from the United States. Were the material available students would have the opportunity of studying United States methods and machinery and of becoming acquainted with its products. The university, it is noted, is the leading technical institution of Chile.

**Radar Distance Indicators.** A new radar navigation system which gives the pilot constant indication of his position has been developed by the United States Army Air Forces together with the General Electric Company. Under this system radar equipment in the airplane sends out radio waves of very high frequency which speed at 186,000 miles a second to a centrally located radio beacon in the area which the airplane is approaching. The beams are reflected back to the radar equipment, giving a continuous reading of the distance between the beacon and the airplane. The combination of this distance-measurement system with a direction-finding system would give the pilot all the information necessary for a complete navigation system, as he could continuously fix both his exact distance from and direction to a given point.

**To Convert RCA Television Receivers.** Prewar RCA Victor Division television receivers will be converted to receive programs on the new frequency channels allocated by the Federal Communications Commission, the RCA Service Company, Inc., has announced. All owners of RCA Victor sets have been notified that the company will incorporate revised circuits and reinstall the set in the owner's home at a charge of $30. The new allocations have shifted the frequencies of existing stations both by changing the frequency bands for given channel designations and by moving stations to new channels. RCA Victor receivers now providing for reception on channels 1 to 5 inclusive will be changed to receive programs on channels 2 to 6 inclusive.

**Philco Has Portable Television Studio.** A new portable 35-pound television camera and lightweight "suitcase-type" control equipment have been developed, the Philco Television Engineering Laboratories announced recently. Several of the lightweight cameras can be operated from a single portable master control unit. The control unit may be 500 feet from the cameras, which can be arranged to pick up various angles of the event being recorded.

Effectiveness of the camera was tested at the University of Pennsylvania football games in the autumn of 1945. Pictures of better definition and detail were obtained by utilizing latest types of camera tubes and new electronic circuits for auxiliary units.

**Transformers for Electronic Heating.** New lightweight transformers in sizes between 2 and 50 kva single phase and 2 and 100 kva three phase have been developed by the Westinghouse Electric Corporation for electronic heating purposes. The transformers are air cooled and can be insulated for test voltages as high as 20,000 volts, which is nearly double the maximum of previous air-cooled transformers. One representative unit using type-C Hipersil core, high-temperature insulation, and air-blast cooling weighed 275 pounds. The same unit built with class A insulation and self-cooled, would have been 1,600 pounds.

**Kellogg and Philco Work Jointly.** An exclusive distributing agreement by which the Kellogg Switchboard and Supply Company, Chicago, Ill., will furnish and install frequency modulation mobile radiotelephone equipment manufactured by the Philco Corporation has been signed by the two companies. Mobile radiotelephone units under the agreement will be designed primarily for use in private automobiles, trucks, busses, taxicabs, yachts, and other vehicles and will incorporate the latest electronic developments.

**Electric Truck Survey.** A 350 per cent increase during the past 21 years in the number of battery-powered industrial trucks in use in the United States is revealed in a survey, results of which were announced recently by the Electric Industrial Truck Association, Chicago, Ill. The survey shows 39,782 such trucks in use at the end of 1944 as compared with 11,350 in 1923. It also revealed that use of electric trucks in material-handling systems showed consistent growth of approximately 65 per cent from 1923 to 1931 and more than doubled in the period from 1931 to 1944 although, during the war years, production was curtailed by demands of the war program.

## LIBRARY

### H. W. Craver Retires From ESL Directorship

Doctor Harrison W. Craver, formerly director and secretary of the Engineering Societies Library, has retired after nearly 29 years of service. He will continue to serve in an advisory capacity, however, with the title of consulting librarian.

Doctor Craver began his association with the library in 1917 and under his leadership the library has extended its facilities for reference and its opportunities for research to a very great number of persons throughout the United States and Canada. In recognition of his long career a statement of appreciation has been prepared to be incorporated in the library board minutes and a copy presented to Doctor Craver.

Ralph H. Phelps, formerly assistant director, has been appointed acting director.

### Engineering Library Receives Barstow Bequest

A legacy of $10,000, the last of many liberal gifts to the Engineering Societies Library by the late William S. Barstow (F '12), recently has been received from his estate. The income from this endowment now supplies about one fifth of the library revenue. A similar bequest of $10,000 also was made to AIEE.

The prosperity of the library was a major interest to William Barstow, who died in 1943 (*EE, Feb '43, p 76*). He was a member of the Library Board from 1931 to 1942 and of the executive committee of the Board from 1934 to 1942. Between 1935 and 1938 he donated $7,500 to cover the cost of binding and repairing the rare books in the library. Most of these were books from the Latimer Clark collection which was given to the library through the AIEE by Schuyler Skaats Wheeler. In 1940 William Barstow gave $500 for the extension of the services of the library.

### Future Meetings of Other Societies

**American Public Power Association.** Annual meeting, May 9–10, 1946, Memphis, Tenn.

**American Chemical Society.** National Chemical Exposition. September 10–14, 1946, Chicago, Ill.

**American Society for Testing Materials.** Annual meeting. June 24–28, 1946, Buffalo, N. Y.

**American Society of Mechanical Engineers.** Annual meeting, June 17–20, 1946, Detroit, Mich.

**American Society of Tool Engineers.** Exposition. April 8–12, 1946, Cleveland, Ohio.

**Canadian Electrical Association.** Annual meeting, June 26–28, 1946, Banff, Alberta, Canada.

**Edison Electric Institute.** June 3–5, 1946, New York, N. Y.

**Electrochemical Society.** Spring meeting. April 10–13, 1946, Birmingham, Ala.

**Great Lakes Power Club.** Spring meeting. May 24, 1946, Chicago, Ill.

**Illuminating Engineering Society.** National convention. September 18–21, 1946. Quebec, Quebec, Canada.

**Instrument Society of America.** Exhibit and conference. September 16–20, 1946, Pittsburgh, Pa.

**National Association of Corrosion Engineers.** Annual meeting and convention. May 7–9, 1946, Kansas City, Mo.

**National Electrical Manufacturers Association.** First International Lighting Exposition. April 25–30, 1946, Chicago, Ill. June 17–19, 1946, Hot Springs, Va.

**National Fire Protection Association.** June 3–6, 1946, Boston, Mass.

**Pennsylvania Electric Association.** Spring meeting. May 28–29, 1946, Harrisburg, Pa.

**Radio Manufacturers Association.** Trade show. May 13–16, 1946. Chicago, Ill.

**Society of Plastics Industry.** First national plastics exposition. April 22–27, 1946, New York, N. Y.

## OTHER SOCIETIES

### Westinghouse Centennial Commemorated by ASME

With "George Westinghouse—the Man and the Engineer," as their theme, prominent speakers recently addressed a dinner at the Engineers Club, New York, N. Y., sponsored by the American Society of Mechanical Engineers to honor the centennial of the birth of George Westinghouse, who was an ASME president.

D. Robert Yarnall of Philadelphia, Pa., president of the ASME, presided, and Dean Dexter S. Kimball of Ithaca, N. Y., a past president, was toastmaster. Other speakers included Albert N. Williams of Pittsburgh, Pa., vice-chairman of the board of the Westinghouse Air Brake Company; Dean Samuel W. Dudley of the School of Engineering, Yale University, New Haven, Conn.; and Frank D. Newbury (F '21) vice-president of the Westinghouse Electric Corporation, Pittsburgh.

Speaking on "Westinghouse—the Individualist," Mr. Newbury urged recognition of individual initiative, co-operation of employer and worker, and business leadership as three essentials of a sound national economy. He charged that "co-operation between employers and employees and between businessmen and the public has been systematically undermined by government and by labor-union propaganda."

He decried the comtemporary emphasis on equalizing purchasing power as against equalizing earning power and the fact that "The people have been taught that profits are a social evil, that in some way—never explained—everyone could enjoy a life of abundance if only industry were not strangled by the profit motive." Savings out of profits enable industry to increase its productivity and thereby increase real wages, Mr. Newbury reminded his hearers.

Defending business leadership, Mr. Newbury stated that American business has no reason to apologize for its record. "Industrial leaders—at their worst of self-seeking and abuse of power—were producing, were developing the country, were increasing jobs and incomes. They could advance their own interests most by increasing production. They couldn't help being on the side of production," he continued.

"But political leaders and labor leaders—at their best—can only help industry produce. They do not directly contribute to the production of wealth. Their major purpose is to redistribute wealth. At their worst—and we have seen some of it during the past few months—political and labor leaders get in the way of production, jobs, and better living," he said.

Stating that planned economy is fallacious, because growth cannot be planned, Mr. Newbury concluded his speech: "The development of an idea, an invention, an industry, is unpredictable. Growth or stagnation is in the hands of our leaders. George Westinghouse, engineer, organizer, individualist, would surely approve of that."

Mr. Williams' topic was "Westinghouse's Position in the History of Transportation." In praising the accomplishments of American railroads, which in 1943 handled double the ton-miles volume of freight with 570,000 fewer employees and 650,000 fewer cars than in 1917, he gave credit to George Westinghouse. Such accomplishments measure the capability of the air brake as well as the engineering practice established by its inventer, he said.

Mr. Williams also reviewed George Westinghouse's development of the friction draft gear to save wear and tear on rolling stock and its cargo and his innovations in railroad switching and signaling. Out of his basic signal system came centralized traffic control, which found its proving ground in World War II.

"Westinghouse—the Man" was discussed by Dean Dudley, who saw in the inventer "a giant in physique, endurance, intellect, personality, and spirit." Westinghouse was a pioneer in consideration of the welfare of his employees, Dean Dudley pointed out. He was the first employer of his day to inaugurate the Saturday half holiday. He developed the use of labor-saving devices in his factories, improved working and housing conditions for his workers, and provided pensions for their old age.

Gwilym A. Price, president of Westinghouse corporation, made the first announcement of his firm's centennial program, in Pittsburgh May 16, 17, and 18. It will consist of a science and engineering forum, with such noted participants as Doctor Karl T. Compton (A '31) president of Massachusetts Institute of Technology; Doctor Vannevar Bush (F '24) director of Office of Scientific Research and Development; Doctor Selman A. Waksman, discoverer of the new drug, streptomycin; Doctor Enrico Fermi of the University of Chicago; Major General Roger B. Colton of the Army's radar and electronics program; Doctor Frank B. Jewett (F '12) president of the National Academy of Sciences; Charles Kettering (F '14) of General Motors Corporation, and other leaders in the fields of science, engineering, and industry.

## National Safety Council Opens Drive for Funds From Public

For the first time in its 33-year history the National Safety Council has launched a nation-wide appeal for funds to support its far-reaching accident prevention work. The Council, which was organized for public safety in 1913, and has existed hitherto with the financial backing of a small group of industrial concerns and individual contributors, has been credited with saving at least 330,000 lives that might have been lost had the accident rate continued at the 1913 level.

By gaining the financial support of the public at large, the Council hopes also to obtain more active participation by the general public in efforts to control the number of accidents in the country. It plans to make the Green Cross, official insignia of the drive, an omnipresent reminder against possible carelessness.

In announcing the campaign, Ned H. Dearborn, president of the Council, compared the number of deaths and injuries from accidents and from World War II. "During the war, deaths and injuries from accidents on the home front exceeded battle casualties among the American forces," he declared. "Our losses from enemy action were 261,608 killed, and 651,911 injured. Home front accidents of all types during this period claimed 355,000 lives and brought injuries to 36,000,000 persons, no less than 1,250,000 of these injuries being of a permanent nature."

Mr. Dearborn also noted that there were 96,000 Americans killed last year in all types of accidents—equivalent to the annihilation of six full infantry divisions. At least 10,300,000 persons were injured in all accidents in 1945 alone—a total approximating the peak war strength of the armed forces of the United States.

## ASTM Studies Electrical Materials

A study group of the American Society for Testing Materials recently was set up to plan for the enlarged scope of the ASTM committee B-1 on materials for electrical conductors. The committee's work now will include all of the common materials used for electrical conductors rather than being limited to copper and copper-alloy wires.

As a result of the reports of task groups appointed for the purpose of recommending changes in parts of present specifications, consideration is being given to preparing methods of tests for determining the actual areas of cross section of finished stranded conductors, either on a weight or resistivity basis. The conversion of specifications B 193–45 T from a resistivity basis to a conductivity basis also is being considered and a task group has been appointed to review specifications B 9–39 for bronze trolley wire and B 47–39 for copper trolley wire in regard to necessary revisions.

The subcommittee on insulating tape of committee D-11 on rubber and rubber-like materials has recommended the withdrawal of the emergency alternate provisions applied to the specifications for friction tape for general use for electrical purposes (D 69–38) and for rubber insulating tape (D 119–38). Both of these standard specifications will be reverted to the tentative status and revised to include a number of the former emergency provisions. Consideration is being given to new specifications for thermoplastic jackets and a revision and clarification of the ozone test in the methods of testing rubber insulated wire and cable (D 470) has been recommended. In addition the method of heat aging of vulcanized or synthetic rubber by test tube method (D 865) has been modified to lower the test temperature from −25 degrees centigrade to −35 degrees centigrade. A steering committee also will be appointed which will review certain emergency alternate provisions applying to specifications for insulated wire and cable as well as study and co-ordinate the various ASTM specifications for rubber insulation for wire and cable.

A study of problems connected with cathode emissivity has been undertaken by a subcommittee of the committee on electrical heating, electrical resistance, and electric-furnace alloys. The subcommittee is composed of technical representatives of the various receiving tube companies, other interested industrial organizations, colleges, and Government laboratories.

At present four lines of investigation are being followed. A metallurgical group and a chemical group have been formed, and with the co-operation of nine companies the testing of various cathode materials under standard tube conditions is being coordinated by another group. A fourth group is analyzing all data received as well as the actual production experience in the participating companies.

It is the aim of the subcommittee to find a method for testing cathode base metal emissivity which will eliminate the large number of variables occurring when regular tube tests are run. As a first step a standard diode structure is being tested. By picking materials with extremes of results it is expected that information will be obtained through chemical or metallurgical methods which will permit accurate forecasting of results.

**1946 ASHVE Guide Available.** The 24th edition of the "Heating Ventilating Air Conditioning Guide" published by the American Society of Heating and Ventilating Engineers is currently available. It contains 51 technical chapters grouped under general section headings such as "Heating and Cooling Loads," "Heating Systems and Equipment," and "Air Conditioning," plus a membership roll of the Society and 376 pages of equipment data. The latter section is complete with a cross index to aid in finding any desired product. The Guide, 6 by 9 inches in size and bound in blue cloth stamped with gold, may be purchased from the society, 51 Madison Avenue, New York, N. Y., at a cost of $6.

**Resistance Welding Publication.** "Recommended Practices for Resistance Welding," a compilation of recommended practices for the spot and seam welding of low carbon, stainless, and hardenable steels, nickel, monel, and iconel; the projection welding of low carbon and stainless steels; flash-butt welding low and medium forging strength steels; and standard methods for

testing resistance welds, now is available from the American Welding Society, 33 West 39th Street, New York 18, N. Y. Each recommended practice comprises a table of machine settings for current, voltage, time, pressure, and other factors which will produce welds of specified strength in various thicknesses of materials. Tests for tensile properties, shear strength, impact strength, fatigue properties, and hardness are included as well as a complete description of the test specimens, the equipment to be used, and the procedure to be followed, and a section on control of weld quality by statistical methods. Copies are 50 cents each.

**Welding Prizes Increased.** Announcement has been made by the American Welding Society that the amount of the prizes it awards annually for the best technical papers on resistance welding has been increased substantially by the donor, the Resistance Welder Manufacturers Association, so that the awards now total \$2,000. The prizes will be awarded as follows:

*\$750, \$500, and \$200*—For the best, second best, and third best paper respectively, emanating from an industrial source, consulting engineer, or the like, in which the major portion of the subject matter is concerned specifically with resistance welding.

*\$300, \$200*—For the best paper and second best paper emanating from a university source—that is, either from an instructor, student, or research fellow—which is the greatest original contribution to the advancement and use of resistance welding.

The contest, which opened August 1, 1945, and will close July 31, 1946, is open to anyone from the United States, its possessions, and Canada. A member of the American Welding Society in any part of the world is eligible.

# LETTERS TO THE EDITOR

**INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication her in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.**

## Inclusive Professional Engineering Society

*To the Editor:*

The writer read with considerable interest the summary of the annual meeting of the Engineers Council for Professional Development as reported in the December issue of *Electrical Engineering*, pages 461–2. The work being carried on by that organization would appear to be well considered and executed.

The writer is somewhat puzzled by one important omission in the discussions regarding uniform membership grades and professional attributes. The professional engineering laws now in effect in most states would seem to bear directly on these matters and particularly the professional attributes.

The subjects of professional recognition and of legal status are related almost inseparably. The professional engineering laws offer a suitable means of specifying and instituting legal minimum qualifications for engineers and for putting a stop to the present misuse and abuse of the title "engineer" by so many unqualified persons. It is useless to argue that there may be better methods of providing minimum standards than the professional engineering laws. Many of those laws have been in effect for a considerable period of years and the process itself is becoming thoroughly ingrained. It is difficult to conceive any other means by which legal status can be conferred. It is much too late to contemplate turning such authority over to the technical societies. Furthermore, while the great technical societies centered at 33 West 39th Street, New York, have high standards, there are a multitude of other so-called "engineering" societies and it would be a legal nightmare to sort them out on a basis of responsibility.

The ECPD recommendations on uniform membership grades seem quite reasonable. The qualifications recommended for Member are strikingly similar to those required in most states for a Professional Engineer's License. Certainly any institution of uniform membership grades would require a transition period. This well might be accomplished first by recognizing a Professional Engineer's License as qualifying an Associate or nonmember for the grade of Member and then at some suitable future date making such license mandatory for the grade. There would seem no point to the Institute's conducting separate qualifying examination when almost all of the states and all of the Canadian Provinces already have in effect licensing laws with almost identical requirements to those suggested by ECPD.

One disturbing item in the report is the indication that for 12 years the ECPD and the major technical societies have discussed uniform membership grades without being able to come to any decision. The same fate seems to have overtaken many of the important professional activities the committe normally would be expected to deal with. This situation lends emphasis to the proposal for an over-all professional engineering society as first outlined by C. A. Powel and later given concrete expression by James F. Fairman in their respective articles in *Electrical Engineering* (*January 1945, pages 14–16 and June 1945, pages 220–3*).

The Founder Societies and their fellow major technical societies have accomplished an outstanding success in their respective technical fields. Unfortunately the characteristics which have carried them to these successes have kept them from functioning effectively on professional activities and co-ordinating with one another. It is all very well for the ECPD to debate, discuss, and submit propositions and proposals to the societies who then individually sit down consider, discuss, and perhaps reject so that the matter goes back to ECPD for further study and so on.

The only alternative to an over-all professional society would seem to be some organization or council of the major technical societies constituted of representatives with power to act as well as talk. The fate of the American Engineering Council does not augur very well for the success of such an enterprise. It was after thorough consideration of these facts that the writer first secured a Professional Engineer's License and then joined the National Society of Professional Engineers. That group is as yet rather weak numerically but it seems to have the major attributes required for a successful professional society—it can and will be built into the powerful over-all professional engineering society that is needed so badly. In Ohio that thought seems to be gathering strength among engineers.

Please understand that the writer has no intention of belittling ECPD or the AIEE. If ECPD carried out no other function than that of accrediting engineering schools its existence would be justified. The writer has been affiliated with AIEE since 1930 and fully appreciates its leading position as a technical society. The failure of the technical societies to cope with professional developments must be recognized. It is suggested that AIEE propose a joint committee of major technical societies to look into the matter of an over-all professional society and issue a joint report. Perhaps this matter could be referred to ECPD but in any case a time limit should be set and a *definite report* demanded. In any such committee the only functioning responsible professional society, NSPE, must be given adequate consideration. Thirteen years have gone into making NSPE a sound and going organization and they should not be thrown away lightly unless there is a very good reason. It should be kept in mind that the vast majority of NSPE members are also members of one or more of the technical societies and that for the forthcoming year one man, James Fairman, will be a vice-president of both AIEE and NSPE. In short it is time to call a halt to the endless round of talk about forming a suitable professional organization and resort to some concrete action.

JAMES P. MUNROE (A'33)

(Dayton Rubber Manufacturing Company, Dayton Ohio)

## Division of Load With Transformers Operating in Parallel

*To the Editor:*

When transformers are to be operated in parallel to supply continuous heavy loads it is important to determine the division of load between each unit. This is particularly true where the transformers are connected together at the same location with a minimum run of secondary mains to the point of supply.

If two transformers having the same ratio of transformation are connected in parallel to a common load the total secondary current is divided between them approximately in inverse proportion to the impedance ratings. The inverse impedance can be expressed as

$$Y=\frac{P}{Z}=\frac{P}{RW+jLW}$$

$Y$ = admittance
$P$ = size of transformer in kilovolt-amperes
$RW$ = secondary winding resistance
$LW$ = secondary winding reactance
$Z$ = per cent impedance

The impedance rating usually can be obtained from the manufacturer's name plate on the transformer. The values are expressed in per cent of rated secondary voltage and it will be found that they vary considerably for the same manufacturer and same type of transformer. Considerable variation also will be found for the same type of transformer made by different manufacturers.

To illustrate the effect of different impedance ratings on the load division in two transformers, we will assume that a load of 100 kva is to be supplied by two 50-kva transformers connected in parallel. Transformer $A$ has an impedance rating of 2.3 per cent and transformer $B$ has a rating of 3 per cent.

The admittances will be

For transformer $A$ $\quad \frac{50}{2.3}=21.74$

For transformer $B$ $\quad \frac{50}{3}=16.66$

The division of the total load of 100 kva then is

For transformer $A$

$$\text{kva}=\frac{Y_a \times \text{kva}_T}{Y_a+Y_b}=\frac{21.74\times100}{38.4}=56.61 \text{ approximately}$$

$Y_a$ = admittance of transformer $A$
$Y_b$ = admittance of transformer $B$
$\text{kva}_T$ = total load kilovolt-amperes

For transformer $B$

$$\text{kva}=\frac{16.66\times100}{38.4}=43.39 \text{ approximately}$$

Under these conditions transformer $A$ is loaded 113.2 per cent of rated capacity and transformer $B$ is loaded to 86.7 per cent of rated capacity.

To illustrate another application, let it be assumed that two transformers of like ratio are to be connected in parallel to supply a total load of 25 kva. Transformer $A$ is a 15 kva with an impedance rating of 3 per cent and transformer $B$ is a 10 kva with an impedance rating of 2.1 per cent.

The admittance will be

For transformer $A$ $\quad \frac{15}{3}=5$

For transformer $B$ $\quad \frac{10}{2.1}=4.76$

The division of total load of 25 kva then is

For transformer $A$ $\quad \text{kva}=\frac{5\times25}{9.76}=12.8$ approximately

For transformer $B$ $\quad \text{kva}=\frac{4.76\times25}{9.76}=12.19$ approximately

In this case transformer $A$ is loaded only 82 per cent and transformer $B$, which is the smaller of the two, is loaded at 121.9 per cent of rated capacity.

It is felt that this method is the simplest way to obtain values for load division of transformers operated in parallel at the same location and is accurate enough for all practical purposes. This method will be found useful to the plant engineer who may have a large single phase industrial load to handle with a wide selection of idle transformers of different makes and designs to select from.

JAMES H. F. WHITE (A'45)

(District engineer, Westchester Lighting Company Pleasantville, N. Y.)

## NEW BOOKS • • •

**The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books in question.**

ASTM STANDARDS ON ELECTRICAL INSULATING MATERIALS. Prepared by ASTM committee D-9 on electrical insulating materials; Specifications, Methods of Testing; October 1945. American Society for Testing Materials, 260 South Broad Street, Philadelphia, Pa. 545 pages, illustrated, 9 by 6 inches, paper, $3.25. The specifications and test methods covering electrical insulating materials are brought together, with several reports on the significance of the tests and other subjects of interest.

DEMOCRATIC ADMINISTRATION. By O. Tead. Association Press, 347 Madison Avenue, New York, N. Y., 1945. 78 pages, 9¼ by 6 inches, cloth, $1.25. In this small volume, part I, entitled "Creative Management," considers the nature and aims of organizations for social, civic, and character-building purposes in order to establish effective administrative procedures. Part II, "Democracy in Administration," develops in a more general way the thesis that "the process of determining purpose, policy, and method advisedly is seen as shared, and the process of oversight and direction is seen as unified and single."

ELECTRON OPTICS AND THE ELECTRON MICROSCOPE. By V. K. Zworykin, G. A. Morton, E. G. Ramberg, J. Hillier, and A. W. Vance. John Wiley and Sons, Inc., New York, N. Y.; Chapman and Hall, London, England, 1945. 766 pages, illustrated, 8½ by 5½ inches, cloth, $10. Part I of this treatise offers a comprehensive description of the various types of electron microscopes, a nonmathematical discussion of electron optical theories on which they are based, and a practical guide for their effective operation. Part II contains a thorough coverage of the mathematical theory. Important topics considered include: the determination of potential distribution; electron trajectory tracing; magnetic fields and electron motion; electron lenses, their aberrations and corrective measures; and image formation in the electron microscope. A list of references accompanies each chapter.

ELECTRONICS FOR ENGINEERS. Edited by J. Markus and V. Zeluff. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1945. 390 pages, illustrated, 11 by 8½ inches, cloth, $6. The articles, charts, and graphs presented in this volume have been selected from those that have appeared in *Electronics* because constant demand has shown their permanent reference value. Consultation has been made easy by collecting the 142 articles in 27 chapters by subject. Designers and builders will find the data useful and convenient.

FLUOROCHEMISTRY. By J. De Ment. Chemical Publishing Company, Brooklyn, N. Y., 1945. 796 pages, illustrated, 9¼ by 6 inches, cloth, $4.50. The basic concepts of fluorochemistry are defined with description of its characteristic phenomena. The applications of fluorescence, luminescence, and radiation in science, medicine, and industry are explained in simple language. The book describes methods for the preparation of the various luminescent organic substances, dyestuffs and coloring matters, and ultraviolet-emitting inorganic and organic substances and gives qualitative and quantitative tests for their identification. Experimental research results are presented. There is an extensive bibliography and a glossary of terms and notations.

NORMALISATION. By J. Maily, preface by P Salmon. Dunod, Paris, France, 1946. 472 pages, 9¾ by 6½ inches, paper, 375 francs. In this interesting study of standardization, attention is given especially to the legal aspects of the subject and on its effects on the general economy of a country. The principles and methods of standardization and the applications of standards are reviewed in the first section. The second deals with standardization in France. Standardization in Germany and England is reviewed briefly, as is international standardization.

## PAMPHLETS • • •

**The following recently issued pamphlets may be of interest to readers of "Electrical Engineering." All inquiries should be addressed to the issuers.**

**Minimum Specifications for Wirebound Boxes for Industrial Domestic Shipments.** The Wirebound Box Manufacturers Association, 43 East Ohio Street, Chicago 11, Ill.

**A Program for Community Relations.** By Walter Geist. National Electrical Manufacturers Association, 155 East 44 Street, New York 17, N. Y., 14 pages. Copies may be secured at cost.

**How to Rebuild Skilled Labor Force for Peace.** Apprentice-Training Service, United States Department of Labor, 1778 Pennsylvania Avenue, N. W., Washington 25, D. C., 4 pages.

**Electronics Digest.** Published quarterly by the Westinghouse Electric Corporation, Box 168, Pittsburgh 30, Pa.